PROGRAM BOOK

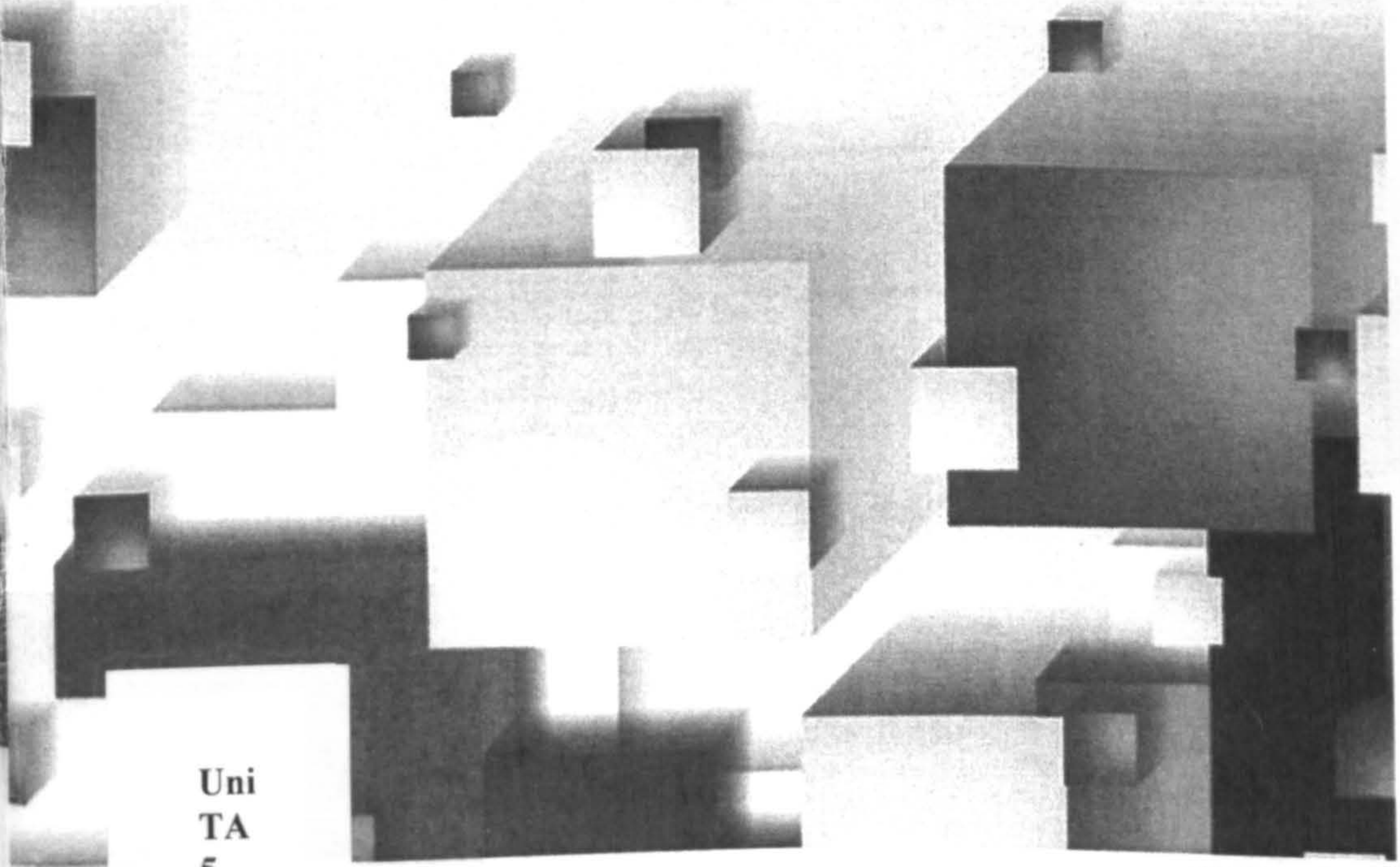
INTERNATIONAL UNIMAS STEM ENGINEERING CONFERENCE

ENCON 2017

ENGINEERING CONFERENCE

"GEARING TOWARDS a GREENER FUTURE"

13-15 SEP 2017 | IMPERIAL HOTEL, KUCHING, SARAWAK, MALAYSIA



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CHIEF MINISTER OF SARAWAK

السلام عليكم ورحمة الله وبركاته

It is a privilege to be invited to officiate this International UNIMAS STEM Engineering Conference EnCon2017, in Kuching, Sarawak. A warm welcome to you eminent scholars, academicians, distinguished delegates and participants. Sarawak is in the edge of a radical transformation of her labour force that would be changing the landscape of the state for generations to come. At the state level, we are in clear track of transforming Sarawak towards Digital Economy and the state government is setting up the Sarawak Multimedia Authority (SMA) which will oversee the development of two new entities, The Sarawak Digital Economy Corporation and the Centre of Excellence for Digital Economy. SMA will set policies and standards for the development of a world-class Digital Sarawak in Infrastructure, Cybersecurity, Digital Government, E-Commerce, Talent Development, Digital Village and Research & Development in Digital Technology. With these new developments in empowering the state of Sarawak, the Sarawak State Government is highly committed in developing human capital to meet the demand for the required skill and knowledge through numerous STEM and TVET Initiatives.

It is hoped that with this conference, closer ties are forged between researchers, academicians, engineers, students and industrial professionals who are collectively working towards achieving the 1.6 million skilled and knowledge workforce in the local front especially for Sarawak Corridor of Renewable Energy (SCORE) by the year 2030.

I am confident that this International UNIMAS STEM Engineering Conference EnCon 2017 will be a great success and the participants would benefit immensely from exchanging scientific, technological and engineering ideas and solutions. It is my hope that this conference would establish stronger ties between individuals and organisations in effort to offer continued engagement in Science and Technology for the progress of the Nation.

Finally, I wish to congratulate UNIMAS, the co-organisers especially Tabung Ekonomi Gagasan Anak Bumiputera Sarawak (TEGAS) and Sarawak Education Department (JPNS) and the organizing committee for their huge efforts in making this event a success. Congratulations!

YAB Datuk Patinggi Abang Haji Abdul Rahman Zohari
Tun Datuk Abang Haji Openg,
Chief Minister of Sarawak

VICE CHANCELLOR OF UNIMAS

Assalamualaikum W.B.T and greetings to all,

YAB Datuk Patinggi Abang Haji Abdul Rahman Zohari Tun Abang Haji Openg, Chief Minister of Sarawak, Distinguished Delegates and all participants.

It is my great pleasure in welcoming all of you delegates and participants to the 10th International UNIMAS STEM Engineering Conference or EnCon 2017.

The Faculty of Engineering UNIMAS has been successfully hosting this annual EnCon conference since 2007. This year, once again, under strategic partnership with Tabung Ekonomi Gagasan Anak Bumiputera Sarawak (TEGAS) and Sarawak Education Department (JPNS), another platform for professionals in the field of science, technology and engineering to build networking and collaborations is organized. This year's theme, that is "Gearing towards a Greener Future" is seen timely as solutions to greener and sustainable technology advances are important especially to address the ever alarming environmental issues such as global issues on climate change and energy crisis. Our distinguished keynote speakers have been invited to share their knowledge and views on various topics in this conference and I hope the two-day intellectual discourse during this event is to reveal several pertinent resolutions on this issue.

With successful introduction of International Science and Engineering Expo (i-STEEx) last year to showcase the latest innovation and research projects by high school students and institutions of higher learning and the industries, once again this year i-STEEx2017 is reaching out to the researchers and innovators with the theme "Nurturing Green Innovation for the Future". This expo will focus on enhancing creativity among the youth to spark innovative interest in science and technology and for institutions of higher learning to showcase their innovative product designs based on green technology. As we strongly advocate STEM education in support of the state's initiative to increase STEM students, parallel sessions of STEM workshops shall also be held for teachers from schools in Sarawak in this 2-day event.

This year is a special year for UNIMAS as we are celebrating our Silver Jubilee Anniversary, our 25th year of continuous educational excellence. In conjunction with this celebration, UNIMAS will also be organizing UNIMAS Silver Jubilee Conference 2017 (USJC2017) from 18 to 20th October 2017 as an initiative to provide a platform to foster national and international cross-societal and organizational research linkages where we will reminisce the various milestones and accomplishments of UNIMAS over the last two decades. We sincerely hope that you will join us in the upcoming USJC2017 and enjoy the conference, activities and our beautiful campus in Samarahan.

We strive to uphold our motto "Contemporary and Forward Looking" and the strong support from Sarawak State Government, industries, and professionals have made it possible for UNIMAS to be a platform for intellectual discourse between academia and industry players on one open forum.

Finally, thank you to all delegates and participants for the support and it is hoped that this conference would be stimulating and would provide valuable experience to all. A big thank to the organizing committee for their huge efforts in making this event a success.

YBhg Prof. Dato' Dr Mohamad Kadim Hj Suaidi
Vice Chancellor
Universiti Malaysia Sarawak

DEAN OF FACULTY OF ENGINEERING

السلام عليكم ورحمة الله وبركاته

Once again, the Faculty of Engineering, UNIMAS, is proud to host the 10th INTERNATIONAL UNIMAS STEM Engineering Conference, EnCon2017.

On behalf of the EnCon2017 organizing committee, I am honored and delighted to welcome you to this prestigious conference.

Our technical program is rich and varied with five keynote speeches and over 100 technical papers. The success of the conference depends ultimately on strong support of the elite members of the International Steering Committee who are prominent scholars.

Various measures are being formulated by both federal and state governments in promoting Science, Technology, Engineering and Mathematics (STEM) among youths, teachers, parents as well as the entire community. The Sarawak State government in particular is very serious in effort to enhance STEM education in school children as the government is in full gear to move Sarawak as the most industrialized and richest state in the country by the year 2030. The integral part of this conference is set with the aim to ensure that the state of Sarawak and ultimately Malaysia shall have sufficient number of qualified STEM graduates to be readily absorbed into science, technical and engineering workforce. With this in mind, UNIMAS in collaboration with Tabung Ekonomi Gagasan Anak Bumiputera Sarawak (TEGAS) and Sarawak Education Department (JPNS) have taken a huge role in organizing International Science Technology and Engineering Expo (i-STEEx2017) which runs in parallel with this EnCon2017 conference.

I am certain that everyone who is part of this conference would benefit immensely and would meet its objectives given the illustrious background of our speakers and the rich mix of the audience with diverse experiences and worldviews. Hence, it is my desire to see this three-day conference from 13-15th September 2017, is able to establish new networks amongst the participants, and break new ground in introducing new research agendas for further exploration.

Lastly, I would like to express my appreciation to the International UNIMAS STEM Engineering Conference, EnCon2017 organizing committee, the Faculty of Engineering and our supporting partners for their initiatives and commitment in spearheading this conference. To all participants, thank you for your support and hope we will see you again in our future EnCon conferences.

Professor Ir. Dr Al-Khalid Haji Othman
Dean, Faculty of Engineering, UNIMAS

السلام عليكم

It is a pleasure to welcome the participants and delegates to our prestigious International UNIMAS STEM 10th Engineering Conference 2017, EnCon2017, the flag ship event of the Faculty of Engineering, UNIMAS. The conference is organized into four major parallel events i.e; Preconference Workshop, iSTEEx Innovation competition, conference parallell sessions and STEM Workshop.

The success of our prestigious event is directly and indirectly resulted from the commitment and dedication of all members of the Faculty as the advisors and the organizing committee, strong support from partners, collaborators and sponsors to whom I convey my gratitude and appreciation. Special gratitude and appreciation goes to TEGAS as the main supporter and sponsor since 2014 as we promote STEM education as part of the event. This also follows as the agenda of our nation. Without their outstanding job and nearly a year of planning, we would not have such an excellent conference.

We hope that you will find the conference both enjoyable and valuable as a platform to collaborate and network among academics and disciplines. Please enjoy the conference while appreciating the natural beauty of Kuching, Sarawak.

Associate Professor Dr Syed Tarmizi Syed Shazali
Chairman
INTERNATIONAL UNIMAS STEM 10TH ENGINEERING CONFERENCE 2017, ENCON2017

ABOUT

International UNIMAS STEM 10th Engineering Conference 2017 (EnCon2017) will be held from September 13 to 15, 2017 in the beautiful city of Kuching, Sarawak. With the theme 'Gearing Towards a Greener Future', the objectives of the current conference are to:

1. Provide a platform for professionals in the field of science, technology, and engineering to build networking for future collaborations

2. Provide a critical discussion platform about new updates in the field of science, technology, and engineering, especially discussion about the theme of the conference

3. Enhance the knowledge in the field of science, technology, and engineering through presentation and sharing of innovative ideas towards a greener and conducive future

4. Foster academic-industrial relationship for the benefit and betterment of the society

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GENERAL INFORMATION

Registration Desk
Registration for the conference will be conducted at the Registration Desk located at Foyer. The registration desk will be opened during the following periods:

11th September 2017 (Monday): 0800 – 1700 (Pre-Conference Workshop)
12th September 2017 (Tuesday): 0800 – 1700 (Pre-Conference Workshop)
13th September 2017 (Wednesday): 0800 – 1700 (Conference + iSTEEx + STEM Education Workshop)
14th September 2017 (Thursday): 0800 – 1700 (Conference + STEM Education Workshop)

Registration for Cultural Visit will be opened near the registration desk on 13th September 2017 (0800-1700) and 14th September 2017 (0800-1200)

Lunch, Morning and Afternoon Tea Break
13th September 2017: Lunch will be served at Imperial Grand Ballroom 2. Morning and Afternoon Tea Break will be served at Foyer.
14th September 2017: Lunch will be served at Imperial Garden Restaurant. Morning and Afternoon Tea Break will be served at Foyer.

Name Badges
For identification and security reasons, delegates are requested to wear their name badges at all times during all conference sessions and at social functions.

Conference Secretariat
The Conference Secretariat room is located at Danum 1. Please visit the Secretariat room if you have any enquiries regarding the conference.

Parallel Oral Presentation
Your presentation is limited to 15 minutes. If your presentation exceeds the time limit you will be asked to stop to avoid encroaching into the next speaker's time slot and disrupting the programme schedule. 5 minutes of Question and Answer time has been scheduled at the end of your presentation.

Website
http://www.conference.unimas.my/2017/encon/

BEM CPD/PDP Hours
11th – 12th September 2017: Pre-Conference Workshop: Introduction to Traffic Crash Investigation and Reconstruction: Towards healthier, safer and more environmental friendly traffic safety system (Ref. no: TBA)
11th September 2017: Pre-Conference Workshop: Introduction to Building Services (Ref. no: IEM17/SWAK/360/C with 5 CPD hours)
11th September 2017: Pre-Conference Workshop: ASHRAE Lectures on Efficient HVAC System (Ref. no: IEM17/SWAK/375/C with 6 CPD hours)
13th September 2017: International UNIMAS STEM Engineering Conference (EnCon) 2017 (Ref no:IEM17/SWAK/372/C with 3 CPD hours)
14th September 2017: International UNIMAS STEM Engineering Conference (EnCon) 2017 (Ref no: IEM17/SWAK/373/C with 3 CPD hours)

OPENING CEREMONY

"Gearing towards a greener future"

Wednesday, 13th September 2017
Grand Ballroom, Imperial Hotel, Kuching

0730 - Registration of participants, presenters for ENCON, iSTEEX and STEM workshop

0830 - Arrival of Delegates and Invited Guests

0850 - Arrival of **YBhg Prof Dato' Dr. Mohamad Kadim Suaidi**
Vice Chancellor of UNIMAS

0855 - Arrival of **YB Datu Haji Len Talif Salleh**
Chairman of TEGAS

0900 - Arrival of **YAB Datuk Patinggi Abang Haji Abdul Rahman Zohari Tun Datuk Abang Haji Openg**
Chief Minister of Sarawak

- National Anthem – 'Negaraku'
- Do'a Recitation
- Video Presentation
- Welcoming Speech by **YBhg Prof Dato' Dr. Mohamad Kadim Suaidi**
  Vice Chancellor of UNIMAS
- Opening Speech by **YAB Datuk Patinggi Abang Haji Abdul Rahman Zohari Tun Datuk Abang Haji Openg**
  Chief Minister of Sarawak
- Conference Launching Ceremony
- MoU and MoA Exchange Session
- Souvenir Presentation
- End of Opening Ceremony
- VVIPs and VIPs proceed to officiate iSTEEX 2017 at Foyer
- Press Conference at Danum 7.

1030 - Morning Tea Break

Date: 11th – 14th September 2017
Venue: Imperial Hotel, Kuching, Sarawak, Malaysia

TENTATIVE PROGRAMME

First Day: 11th September 2017 (Monday)

Pre-Conference Workshop

Time	Activity	
0800 – 0830	Arrival and Registration of Participants	
	Danum 3	**Danum 4**
0830 – 1700	**Workshop 1** Title: Introduction to Traffic Crash Investigation and Reconstruction: Towards healthier, safer and more environmental friendly traffic safety system Speaker: Mr Iskandar Abdul Hamid & Mr. Ahmad Noor Syukri Zainal Abidin (MIROS)	**Workshop 2** Title: Introduction to Building Services Speaker: Prof Ir. Dr. Andrew RH Rigit

Second Day: 12th September 2017 (Tuesday)

Pre-Conference Workshop

Time	Activity	
	Danum 3	**Danum 4**
0830 – 1700	**Workshop 1 (continued)** Title: Introduction to Traffic Crash Investigation and Reconstruction: Towards healthier, safer and more environmental friendly traffic safety system Speaker: Mr Iskandar Abdul Hamid & Mr. Ahmad Noor Syukri Zainal Abidin (MIROS)	**Workshop 3** Title: ASHRAE Lectures on Efficient HVAC System Speaker: Ir. Chen Thiam Leong

Third Day: 13th September 2017 (Wednesday)

<table>
<tr><th>Time</th><th colspan="2">Activity</th></tr>
<tr><td>0800 – 0845</td><td colspan="2">Arrival and Registration of Participants</td></tr>
<tr><td>0845 – 0900</td><td colspan="2">Arrival of Guest of Honour and VIP</td></tr>
<tr><td>0900 – 1000</td><td colspan="2">Opening ceremony
Venue: Imperial Grand Ballroom 1
• Negaraku
• UNIMAS Gemilang
• Doa Recitation
• Speech by UNIMAS Vice Chancellor
• Speech by YAB Datuk Patinggi Abang Haji Abdul Rahman Zohari
• MoU/ MoA Exchange
• Souvenir Presentation</td></tr>
<tr><td>1000 – 1030</td><td colspan="2">Venue: Danum 7 (15 – 20 pax)
• Press Conference</td></tr>
<tr><td>1000 – 1030</td><td colspan="2">Tea Break
Venue: Foyer</td></tr>
<tr><td></td><td>Imperial Grand Ballroom 1</td><td>Foyer (Next to Ballroom 1)</td></tr>
<tr><td>1030 – 1120</td><td>Keynote Session1
Keynote Speaker: YBhg. Prof. Dato Dr. Kamaruzzaman Sopian
Director, Solar Energy Research Institute, UKM
Topic: Recent Advances in Solar Thermal Assisted Air Conditioning Systems for Hot and Humid Areas</td><td rowspan="2">International Science, Technology and Engineering Expo</td></tr>
<tr><td>1120 - 1220</td><td>Keynote Session 2
Speaker: Prof. Mustafizur Rahman, National University of Singapore (NUS), Singapore
Topic: Innovations in Tool-based Hybrid/Compound Micro/Nano-machining for Sustainable Manufacturing
– An Integrated Approach</td></tr>
<tr><td>1220– 1400</td><td colspan="2">Lunch Break (Imperial Grand Ballroom 2) Pax:</td></tr>
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Third Day: 13th September 2017 (Wednesday) (Cont.)

	EnCon 2017				STEM Track	ISTEEx
TIME	Parallel Sessions				Imperial Grand Ballroom 1	Foyer (Next to Ballroom 1)
	Danum 2 ChE	Danum 3 CE 1	Danum 4 EE 1	Danum 5 ME 1		
1400 1420	D2-P01	D3-P01	D4-P01	D5-P01	**STEM Keynote Session** Keynote Speaker: **Prof. Dr. Khairiyah Mohd. Yusof** **Director** **Centre for Engineering Education, UTM** Topic: STEM and Engineering Education: What will an effective learning environment look like in the 4th Intrustrial Revolution?	
1420 1440	D2-P02	D3-P02	D4-P02	D5-P02		
1440 1500	D2-P03	D3-P03	D4-P03	D5-P03		**International Science, Engineering and Technology Expo (ISTEEx)**
1500 1520	D2-P04	D3-P04	D4-P04	D5-P04	Tea Break Venue: Foyer	
1520 1540	**Evening Tea Break Venue: Foyer**				**Ballroom 1 STEM Workshop 1** Speaker: **Assoc. Prof. Dr. Ramlah Zainudin,** **Dean,** **Centre of Pre-University Studies, UNIMAS** Topic: **Institutions of Higher Learning Intake Criteria**	
1540 1600	D2-P05	D3-P05	D4-P05	D5-P05		
1600 1620	D2-P06	D3-P06	D4-P06	D5-P06		
1620 1640	D2-P07	D3-P07	D4-P07	D5-P07		**Ballroom 2 Closing Ceremony for ISTEEx**
1640 1700	D2-P08	D3-P08	D4-P08	D5-P08		
End of Day 3						

Fourth Day: 14th September 2017 (Thursday)

TIME	EnCon 2017				STEM Track
	Parallel sessions				
	Danum 2 ChE	Danum 3 CE 1	Danum 4 EE 1	Danum 5 ME 1	Imperial Grand Ballroom 2
0830 0850	D2-P09	D3-P09	D4-P09	D5-P09	**STEM Workshop 2** Speaker: **Prof. Dr. Rohaida Mohd. Saat** **Dean** **Faculty of Education, University of Malaya** Topic: **STEM Pedagogical Approach**
0850 0910	D2-P10	D3-P10	D4-P10	D5-P10	
0910 0930	D2-P11	D3-P11	D4-P11	D5-P11	
0930 0950	D2-P12	D3-P12	D4-P12	D5-P12	
0950 1010	D2-P13	D3-P13	D4-P13	D5-P13	
1010 1030	**Tea Break** **Venue: Foyer**				
	Venue: Imperial Grand Ballroom 1 Pax: 100				**Imperial Grand Ballroom 2**
1030 1130	**Keynote Session 3** Speaker: **Assoc. Prof. Dr. Pierre Barroy,** **University of Picardies Jules Verne, France** Topic: **Surface Engineering Plasmas for Enhanced Technologies and Greener Societies**				**STEM Workshop 3** Speaker: **Pn Yusma Yusof** **Deputy Director (Academic),** **Politeknik Port Dickson** Topic: **Roadmap PT3-KV-TVET-Bachelor of Technology**
1130 1230	Speaker : **Prof. Ir. Dr. Farid Nasir bin Haji Ani** **Sustainable and Renewable Energy Research Group, Faculty of Mechanical Engineeirng, UTM** Topic: **Microwave Induced Thermal Processing of Bioresources**				
1230 1400	**Lunch Break (Imperial Garden Restaurant)**				

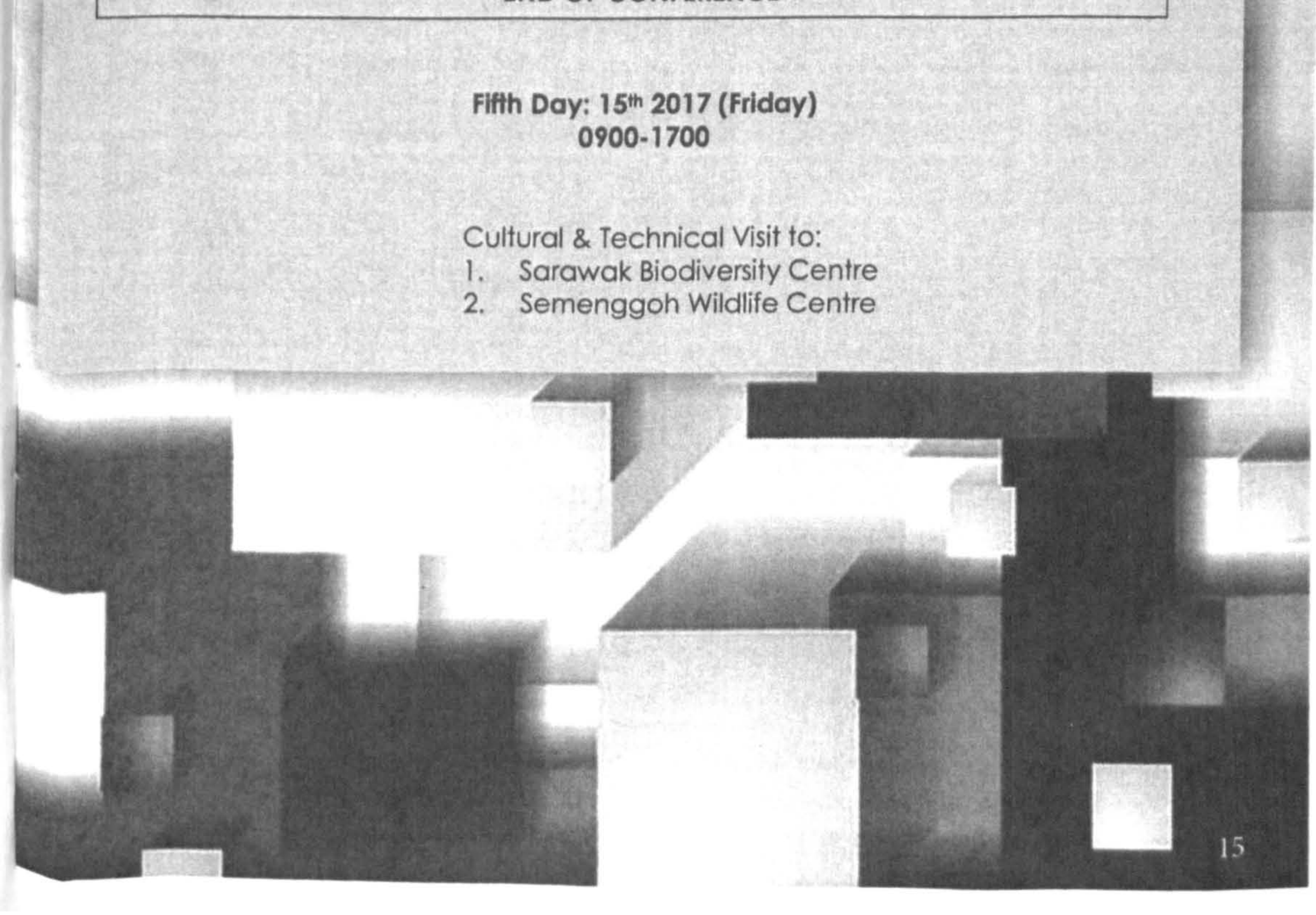
Fourth Day: 14th September 2017 (Thursday) (Cont.)

TIME	EnCon 2017				STEM Track
	Parallel sessions				
	Danum 2 ChE	Danum 3 CE 1	Danum 4 EE 1	Danum 5 ME 1	
1400 1420	D2-P14	D3-P14	D4-P14	D5-P14	Join any Parallel Sessions
1420 1440	D2-P15	D3-P15	D4-P15	D5-P15	
1440 1500	D2-P16	D3-P16	D4-P16	D5-P16	
1500 1520	D2-P17	D3-P17	D4-P17	D5-P17	
1520 1540	**Evening Tea Break Venue: Foyer**				
1540 1600	D2-P18	D3-P18	D4-P18	D5-P18	Join any Parallel Sessions
1600 1620	D2-P19	D3-P19	D4-P19	D5-P19	
1620 1640	D2-P20	D3-P20	D4-P20	D5-P20	
1640 1700					
END OF CONFERENCE					

Fifth Day: 15th 2017 (Friday)
0900-1700

Cultural & Technical Visit to:

1. Sarawak Biodiversity Centre
2. Semenggoh Wildlife Centre



KEYNOTE SPEAKERS

Prof. Dato' Dr Kamaruzzaman Sopian
Director, Solar Energy Research Institute, Universiti Kebangsaan Malaysia

RECENT ADVANCES IN SOLAR THERMAL ASSISTED AIR CONDITIONING SYSTEMS FOR HOT AND HUMID AREAS

Date: 13th September 2017

Abstract:
Solar thermal air conditioning refers to any air conditioning or cooling system that uses solar thermal energy. The most common solar assisted air conditioning systems are absorption, adsorption and desiccant cooling system. The disadvantages of solar thermal air conditioning system compared to the conventional vapor compression cycle are many additional components and also large solar collector area. The main advantage of solar thermal air conditioning system is that it uses less electricity and uses thermal energy. Three advanced solar cooling systems have been developed (a) a solar adsorption system (b) solar absorption system with flash tank and ejector and with nanofluids for heat transfer enhancement and (c) liquid and solid desiccant cooling systems. The way forward for solar thermal cooling technology is the development of more compact design that will enable the usage of less collector area with the same performance making it more cost competitive.

Professor Ir Dr Farid Nasir Ani
MIEM, P.Eng, MINDS, FSOE(UK), FIPlantE(UK), MIMarEST(UK), C.Eng. MASHRAE.
Sustainable and Renewable Energy Research Group (SURE),
Faculty of Mechanical Engineering, Universiti Teknologi Malaysia

MICROWAVE INDUCED THERMAL PROCESSING OF BIORESOURCES

Date: 14th September 2017

Abstract:
Energy crisis and continuously fluctuating cost of petroleum have move attention of researchers toward renewable and sustainable energy and materials sources. Biomass or bioresources are available in abundantly and cheap sources that are environment friendly in tropical countries. It has been identified as one of the main sources of the sustainable and renewable energy in Malaysia. One example of utilization of biomass is in the processing of palm oil in Malaysia. The presentation describes several possible routes to provide energy as well as potential value-added products from bioresources. The trend in thermo-conversion processing of the biomass is the application of microwave energy into renewable biofuels, materials and chemicals. The potential uses of agro-products and agro-solid wastes for biofuels, materials and chemicals are highlighted. The applications of these renewable sources to produce biofuels, materials and chemicals have been applied in some countries around the world. The implementation of the biomass technology will be feasible and able to utilize when the technology is developed, fabricated and commission locally with locally produced biomass. With advanced research and development efforts, together with local expertises, indigenous technologies could be produced, thus reducing the high cost of import technology.

Prof Dr Mustafizur Rahman
Department of Mechanical Engineering, National University of Singapore

INNOVATIONS IN TOOL-BASED HYBRID/COMPOUND MICRO/NANO-MACHINING FOR SUSTAINABLE MANUFACTURING – AN INTEGRATED APPROACH

Date: 13th September 2017

Abstract:

In recent years, there has been a remarkable development in manufacturing technologies and design of machine tools. This is in tandem with greater demand for better performance quality of products. Both 'revolutionary' and 'evolutionary' innovations are the keys to meet the challenges posed by the needs of functional requirement of products, miniaturization, and industrial realization of micro/nanotechnology. These limitations can be overcome by taking an integrated approach towards innovation through: (1) compound machining processes, and (2) development of proper machine tools supporting such machining processes to meet the demand for machining difficult-to-cut materials with quality and complexity.

Conventional machining processes (material removal processes, such as turning and milling), have been hybridized or compounded with non-conventional machining processes like EDM (electro discharge machining), EDG (electro discharge grinding), ECM (electro chemical machining), wire-EDM and Laser to fabricate micro-structures with high dimensional accuracy, and such processes are termed as 'compound machining'. In order to achieve meaningful implementation of compound machining techniques, understanding of process physics to provide relevant background for modeling, measurement and identification of control parameters are of utmost importance. Implementation of this concept can be successfully carried out through the adaptation of Digital Manufacturing.

For successful implementation of such compound machining technique, design and development of machine tools capable of such complex machining (i.e. turning, milling, EDM, laser, etc. on the same machine and setup) are needed.

An integrated approach for successful implementation of material, manufacturing processes and design can only be achieved through a paradigm shift in thought and processes of conventional machining. This shift can only be materialized through revolutionary innovation rather than an evolutionary one.

An attempt has been made in this presentation regarding the mindset, activities and achievements of the author, his group members at National University of Singapore (NUS), and some research partners in other parts of the world for successfully achieving this objective.

Dr Pierre Barroy
University of Picardie Jules Verne, France

SURFACE ENGINEERING PLASMAS FOR ENHANCED TECHNOLOGIES AND GREENER SOCIETIES

Date: 14th September 2017

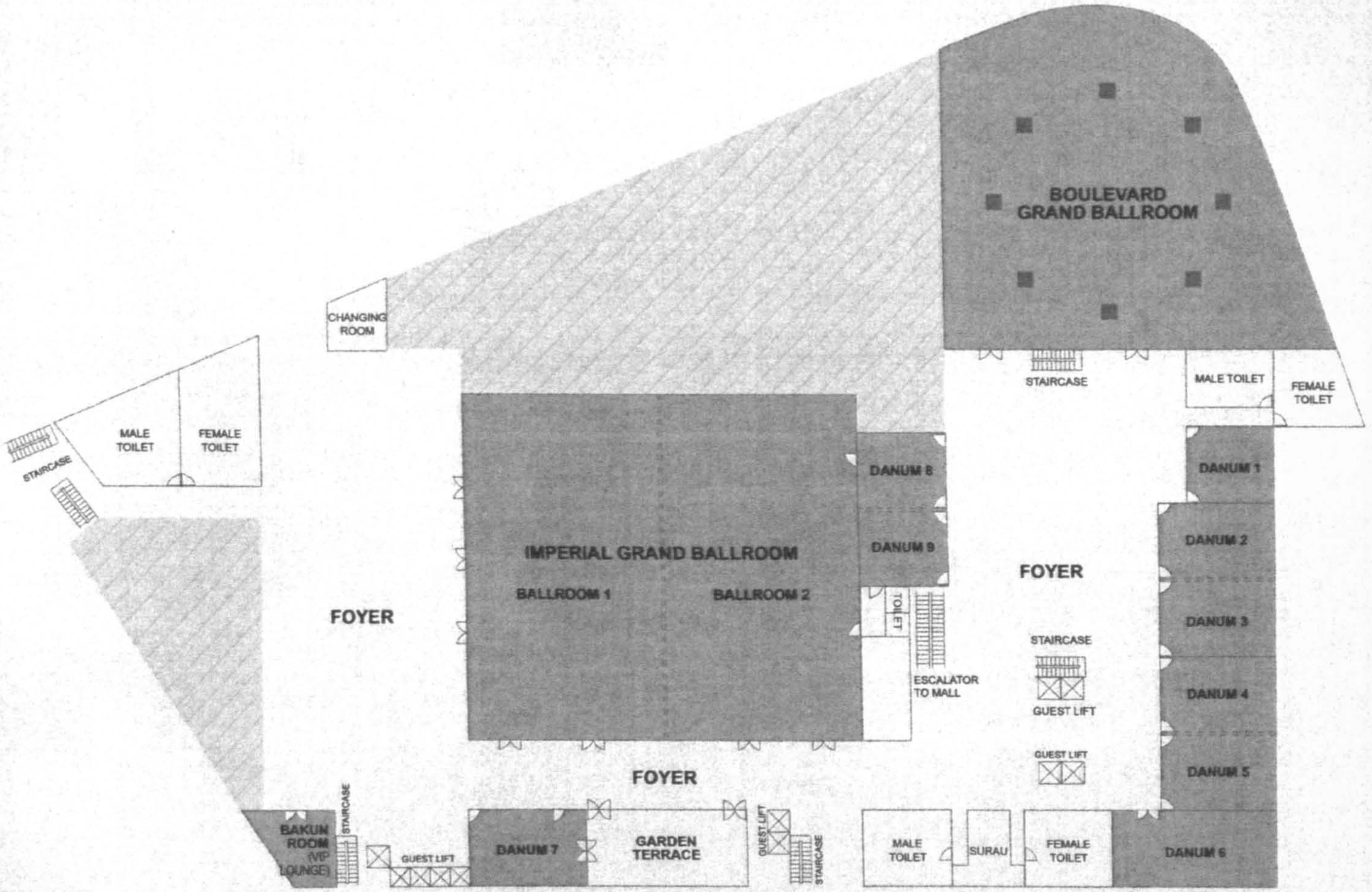
Abstract:

With an expanding world population on a finite Earth, resources have been rapidly diminishing. Bulk materials are now in high demand everywhere and the demand in functionalities cannot be met by those materials anymore. Introducing surface functions on bulk materials can enable much needed resource savings and more efficient use of energy sources.

In this review, we will present a survey of this field with an emphasis on passive systems using an interaction with their environment for energy gains in particular. Many environmental stimuli
can be tapped by smart surfaces made from physically interacting materials. Typically, parameters such as temperature, humidity, or illumination are such interesting stimuli.

Here, we will review existing and promising solutions brought thanks to plasma processing. Non-equilibrium plasmas enable low-temperature, tailored energy delivering to surfaces and we will review in particular combined effects that can be exploited, for renewable energies or property enhancements in natural resources, such as smart blades for water turbines.

FLOOR PLAN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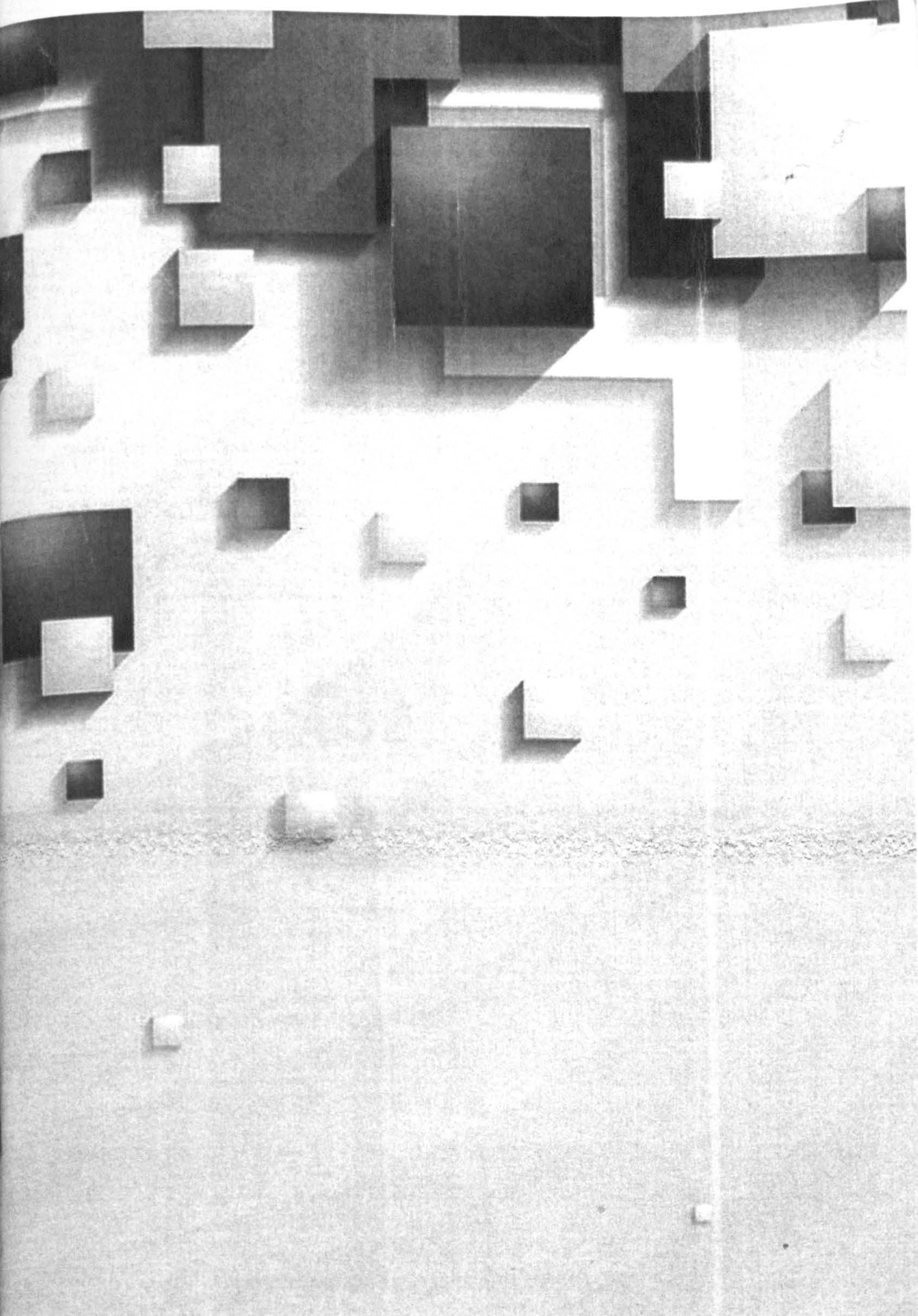

ENCON2017 TECHNICAL PARALLEL SESSION 1

13th September 2017 (Wednesday)

TIME	Parallel Sessions			
	Danum 2 ChE Prof. Dr Hj. Mohammad Omar Abdullah	**Danum 3 CE 1 Prof. Dr Ng Chee Khoon**	**Danum 4 EE 1 Prof. Dr Musse Mohamud Ahmed**	**Danum 5 ME 1 Prof. Dr Shahidul**
1400 1420	D2-P01 **Eugene Jackson Joy (107)** *Effects Of Hydraulic Retention Time And Solid Retention Time Of POME On COD Removal Efficiency*	D3-P01 **Hamidun Bin Mohd Noh (93)** *Impact Of Cover/Bar Diameter Ratio To The Structural Performance Of Reinforced Concrete Member Due To Corrosion*	D4-P01 **Yonis. M. Yonis Buswig (36)** Voltage Tracking Of A Multi-Input Interleaved Buck-Boost DC-DC Converter Using Artificial Neural Network Control	D5-P01 **Handie Ahmataku (90)** *Analysis Of Gate Poly Delayering In SOI Wafer*
1420 1440	D2-P02 **Khairul Anwar Mohamad Said (20)** *The Relationship Of Silver Content On Water Flux Of Polysulfone Composite Membrane*	D3-P02 **Mohd Rashdan Saad (69)** *The Role Of Building Layout In Haze Reduction*	D4-P02 **Siti Kudnie Sahari (70)** *Surface Analysis Of Thermally Growth Ge Oxide On Ge(100)*	D5-P02 **Nurfairuz Nadirah Affandi (21)** *Multiple-Objective Optimization Techniques In Laser Joining/Welding Of Dissimilar Materials Classes: A Comparison Between Grey And Ratio Analyses*
1440 1500	D2-P03 **Tausif Ahmad (76)** *Study On Effect Of Volume Of Gold Choloroauric Acid On Size, Shape And Stability Of Biosynthesized Gold Nanoparticles Using Aqueous Elaeis Guineensis (Oil Palm) Leaves Extract*	D3-P03 **Mohamad Tazuddin Adrus (2)** *Collaborative Location-Based Mobile Game With Error Detection Algorithm*	D4-P03 **Erdawaty Mohd Jaafar (35)** *Study Of Morphology, Optical And Electrical Properties Of Graphene Oxide Thin Film Depends On The Reaction Time Of Synthesis*	D5-P03 **Wong Wei Kitt (12)** *Euclidean Space Data Projection Classifier With Cartesian Genetic Programming (CGP*
1500 1520	D2-P04 **Loi Hoang Huy Phuoc Pham (15)** *Simulation Analysis Of Initial CO2 Bubble Formation In Seawater Using VOF Method*	D3-P04 **Nurul Syakeera Nordin (26)** *Evolution Of Shear Strength With Varying Cement Dosages In Dredged Marine Soils*	D4-P04 **Muhammad Mujahid Muhammad (101)** *Artificial Neural Network Applications For Predicting Drag Coefficient In Flexible Vegetated Channels*	D5-P04 **Shahriar Shams, (53)** *Challenges And Opportunities Of Green Roof In Building Design: A Case Study From Bandar Seri Begawan*
1520 1540	**Evening Tea Break Venue: Foyer**			
1540 1600	D2-P05 **Muhammad Mubashir (97)** *Enhanced Gases Separation Of Cellulose Acetate (CA) Membrane Using N-Methyl-2-Pyrrolidone As Fabrication Solvent.*	D3-P05 **Ding Sie Hao (85)** *Synthesis Of KIT-6 Silica And Preparation Of Mixed Matrix Membranes By Incorporating KIT-6 Into Cellulose Acetate Membrane*	D4-P05 **Dyg Norkhairunnisa Abang Zaidel (58)** *Design And Analysis Of Slotted Ring Wideband Bandpass Filter For Microwave Sensor To Measure Rice Quality*	D5-P05 **Mahshuri Yusof (75)** *Tensile Properties Of Clam Shell Powder-Filled Unsaturated Polyester Composites*
1600 1620	D2-P06 **Nurul Aini Amran (57)** *Effect Of Freezing Time And Shaking Speed On The Performance Of Progressive Freeze Concentration Via Vertical Finned Crystallizer*	D3-P06 **Siti Farhanah S.M Johan (28)** Effect Of Granular Inclusion On The Consolidation Rate Of Dredged Marine Clay	D4-P06 **Law Kah Haw (45)** *Lead Compensator Design For Single-Phase Quasi Z-Source Inverter*	D5-P06 **Javed Akhter (77)** *Design And Optical Modeling Of A Low Profile Stationary Concentrating Solar Collector For Medium Temperature Heat Supply*
1620 1640	D2-P07 **Umair Sikander (18)** *Effects Of Catalyst Bed Position On Hydrogen Production By Methane Decomposition*	D3-P07 **Suraya Hani Adnan (13)** *Additional Of Cement Leftover From The Hollow Of The Spun Pile Reinforcement As An Additive To Scc*	D4-P07 **Ma Quanjin (38)** *Design Of Portable 3-Axis Filament Winding Machine With Inexpensive Control System*	D5-P07 **Siti Hawa Nabilah Zahari (19)** *Minimum Ignition Energy Of Engineered Nanomaterials (Enms)*
1640 1700	D2-P08 **Muhammad Athar,(72)** *Integrated Safety And Process Optimization Approach For Ammonia Synthesis Loop*	D3-P08 **Nuraslah Mira Anuar (24)** *Passive Pathogenic Removal In Leachate: Monitoring Of E. Coli Count*	D4-P08 **Mohd Hafiez Izzwan (113)** *Water Tree Simulation On Underground Polymeric Cable Using Finite Element Method For Research Purpose*	D5-P08 **Hilton Ahmad (86)** *Multi-Holes Configurations Of Woven Fabric Kenaf Composite Plates: Experimental Works And 2-D Modelling*

ENCON2017 TECHNICAL PARALLEL SESSION 2

14th September 2017 (Thursday)

TIME	Parallel sessions			
	Danum 2 CE 1 Assoc. Prof. Ir. Dr Siti Noor Linda Taib	**Danum 3 EE 1 Assoc. Prof. Dr Hushairi Zen**	**Danum 4 ME 1 Assoc. Prof. Dr Syed Tarmizi Syed Shazali**	**Danum 5 ChE Assoc. Prof. Dr Cirilo Nolasco**
0830 0850	D2-P09 **Nasser Rostam Afshar (46)** *Impact Of Climate Change To Water Resources*	D3-P09 **Sim Sy Yi (33)** *Power Factor Improvement In Power System With The Integration Of Renewable Energy*	D4-P09 **Muhamad Mat Noor (98)** *Performance, And Emission Characteristics Of Single Cylinder CI Engine Operated With Fusel Oil – Diesel Blend*	D5-P09 **Atta Ullah (4)** *An EMMS Mixture Model With Bubble Size Distribution*
0850 0910	D2-P10 **Alvin John Lim (43)** *Relationship Between Undrained Shear Strength (Su) And Consolidation Ratio For Cohesive Soil (Marine Clay)*	D3-P10 **Falih Alkhafaji (40)** *Proposed Optimisation Proportional Integral Derivative Controller Based On Second And Third Plant Model*	D4-P10 **Charlie Sia Chin Voon (25)** *Weibull Analysis On Banana Fiber Strength With Variation Of Within Fiber Cross-Sectional Area*	D5-P10
0910 0930	D2-P11 **Ting Wee Kiet (23)** *Interfacial Friction Behaviour In Narrow Wall Paste Backfill System*	D3-P11 **Nasir Shehzad (89)** *Graphene Oxide As An Efficient Photocatalyst For Photocatalytic Reduction Of CO2 Into Solar Fuel*	D4-P11 **Melissa Augustine Saidi (30)** *The Optimum Sodium Hydroxide Concentration For High Strength PLA-Rice Straw Composites*	D5-P11 **Muhammad Syafiq Hazwan Ruslan (29)** *Kinetic Model Of Supercritical Fluid Extraction Of Areca Catechu (Betel Nut)*
0930 0950	D2-P12 **Jeffrey Yap Boon Hui (6)** *Managing Design Change Dynamics In Building Construction: Conceptualising A Qualitative Model*	D3-P12 **Dayang Siti Amira Awang Yusuf (95)** *Design Of CMOS Power Amplifier With Resistive Feedback And Notch Filter For UWB System*	D4-P12 **Muhammad Naim Leman (91)** *Design, Fabrication And Evaluation Of A New Keropok Keping Drying Machine*	D5-P12 **June Bong Yin Chung (80)** *The Effect Of Amine Substituent Chain Length On Polyhedral Oligomeric Silsesquioxane/Polysulfone Mixed Matrix Membrane*
0950 1010	D2-P13 **Muhammad Yasir Shamim (87)** **Implementation of** *Safety*	D3-P13 **Shafrida Sahrani (108)** *Modeling And Simulation Study Of A*	D4-P13 **Rashidah Salim (66)** *A Review On Ruben's Tube As Acoustic Propagator*	D5-P13 **Siti Nur Azella Zaine(79)** *Effect Of Paste Viscosity On Direct-*

	Performance Framework (SPF) in process industries to avoid disasters	*High Speed Moving Target*		*Current Resistance In Improving The Efficiency Of Dye Solar Cell*
1010 – 1030	Tea Break Venue: Foyer			
1030 1130	Ballroom 1 Chairperson : Prof. Dr Sinin Hamdan Keynote Session 3			
1130 1230	Ballroom 1 Chairperson : Prof. Dr Sinin Hamdan Keynote Session 4			
1230 1400	Lunch Break (Imperial Garden Restaurant)			


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ENCON2017 TECHNICAL PARALLEL SESSION 3

14th September 2017 (Thursday)

TIME	Parallel sessions			
	Danum 2 CE 1 Assoc. Prof. Dr Mohammad Ibrahim Safawi	**Danum 3 EE 1 Assoc. Prof Dr Mohammad Abdelmoneim**	**Danum 4 ME 1 Prof. Dr Amir Azam Khan**	**Danum 5 ChE Assoc. Prof. Dr Khairuddin Sanaullah**
1400 1420	D2-P14 **Rosmaini Tasmin (106)** *Integrating Student Class Attendance Into University Information System For Seamless Monitoring Approach*	D3-P14 **Saidu Abubakar Adamu (60)** *High-Gain Modified Antipodal Vivaldi Antenna For Ultra Wideband Applications*	D4-P14 **Ting Tiew Wei (64)** *Heat And Flow Characteristics Of Nanofluid Flow In Porous Microchannels*	D5-P14 **Nurul Afiqah Mokri (88)** *Synthesis Of High Molecular Weight Polyimide Consisting Hexafluoroisopropylidene Moiety For Gas Separation*
1420 1440	D2-P15 **Taofeeq Sholagberu Abdulkadir (6)** *Geospatial Assessment Of Soil Moisture Distribution In Mountainous Watershed Using GIS And Remote Sensing Techniques*	D3-P15 **Sylvia Ong Ai Ling (47)** Distributed Double Differential *Space-Time Coding With Amplify-And-Forward Relaying In Cooperative Communication System*	D4-P15 **Magdalene Andrew-Munot (68)** *Analysis Of Production Planning Activities In Remanufacturing System*	D5-P15 **Muhammad Ishaq Khan (8)** *Probabilistic Ecotoxicological Risk Assessment Of Imidazolium Ionic Liquids With Amino Acid And Halide Anions*
1440 1500	D2-P16 **Striprabu Strimari (115)** *Study On Influence Of Moisture Content In Cement Stabilized Serian Soil*	D3-P16 **Mohd Ridhuan Mohd Sharip, Dyg (84)** *Effect Of Interphase Region And Neighboring Particles On Electric Field Intensity Within Nanocomposite Systems*	D4-P16 **Hasanain A. Abdul Wahhab (48)** *Application Of Electromagnetic Induction Technique To Measure The Void Fraction In Oil/Gas Two Phase Flow*	D5-P16 **Dewi Harreh (49)** *Biodiesel Production From Crude Karanja Oil Using Meretrix Lyrata Synthesized Active Cao Catalyst*
1500 1520	D2-P17 **Lim Chung Han** *Use Of Quarry Dust As Sand Replacement In Structural Concrete: A Review*	D3-P17 **Ariny Demong (111)** *Tracking Of Swirl Bubbles Using High Speed Camera*	D4-P17 **Afaque Ahmed (83)** *Rheology And Interfacial Tension Of Internal Olefin Sulphonate Coated Nano-Silica For Enhanced Oil Recovery*	D5-P17 **Muhammad Babar (81)** *Simulation Based Study On Identification And Quantification Of CO2 Solidification In Cryogenic CO2 Capture From Natural Gas*
1520 1540	**BREAK**			
1540 1600	D2-P18 **Mohammad Zawawi Rosman (61)** *Time-Dependent Compressibility Behaviour Of Dredged Marine Soils (DMS) Admixed With Cement And/Or Waste Granular Materials (WGM)*	D3-P18 **Dyg Norkhairunnisa Abang Zaidel (92)** *Improvement On The Bandwidth And Scattering Parameter Performances Of 5G Branch-Line Coupler Design For The Use In Intelligent Transportation System (ITS*	D4-P18 **Nazreen Junaidi (51)** *Development Of Kek Lapis Sarawak's Automated Cooling And Pressing System By Using PLC*	D5-P18 **Latifah Abdul Ghani (94)** *The Use Of MFA And LCA In The Agriculture Waste Management System In Kuala Terengganu, Malaysia*
1600 1620	D2-P19 **Omer Iqbal (44)** *Identification Of Brittle Zones Of Potential Roseneath Shale Gas, Cooper Basin, Australia Using Geomechanical Properties And Mineralogy.*	D3-P19 **Mohammad Ashaari Kiprawi (103)** *Development Of Cutting Edge Temperature Measurement Of End Mill Tool By Infrared Radiation Technique*	D4-P19 **Abdul Basit (52)** *Droplet Spreading Behavior On Urea Pellets*	D5-P19 **Mohd Nurfirdaus Mohiddin (65)** *A Study On Chicken Fat Biodiesel Production, Characterization And Diesel Engine Performance*
1620 1640	D2-P20 **Pannir Selvam Murugiah, (78)** *A Study On The Performance Of Ppodm-CNF Mixed Matrix Membrane For CO2/CH4 Separation.*	D3-P20 **Nor Asiah Muhamad (114)** *Understanding Of High Voltage Stress Distribution Phenomena On Liquid And Solid Insulation Material Using Finite Element Method For Research Purpose*	D4-P20 **Sherra Bellina Barrabas (109)** *Hydrocarbon-Selective Catalytic Reduction As Nitrogen Oxides Emissions Reduction: A Short Review*	D5-P20 **Norwahyu Jusoh (82)** *The Effects Of Amine-Functionalization On Zeolite T/6FDA-Durene Mixed Matrix Membranes For CO2/CH4 Separation*
1640 1700	**D2P21**			**D5P21** **Muhammad Tariq Bashir (73)** *Monitoring Kinetic And Thermodynamic Parameters Of Fluoride Adsorption From Aqueous Solution By PKS-Based Anion Resins*

Interfacial Friction Behaviour in Narrow Wall Paste Backfill System

[1]Wee K. Ting, **[2]Alsidqi Hasan, [3]Fauzan Sahdi, [4]Siti N. Taib, [5]Norsuzailina M. Sutan, [6]Badhrulhisham A. Aziz, and [7]Andy Fourie

Abstract

Understanding on the effects of interfacial friction within narrow wall is important in the design of underground stope backfill system. Laboratory scale stope model made of metal such as aluminium is normally used to simulate the actual stope paste backfill system, however, verification of such system in terms of interfacial friction behaviour is lacking. This paper presents the experimental results on the interfacial friction between backfill material and the aluminium narrow wall system as well as the internal friction of the paste backfill. Standard and modified direct shear tests are employed to investigate such behaviours under dry and saturated conditions for uncemented paste backfill (UCPB) and cemented paste backfill (CPB). For the CPB, cast in-situ and precast is also compared. The shear stress-strain behaviour is showcased in detail for every test. The general findings show that the interfacial friction angle (δ) at the backfill-aluminium interface is weaker than internal friction angle (ϕ) of the backfill itself with an average factor of 0.69 (δ/ϕ=0.69). This factor is comparable to 2/3 or 0.67 which is commonly used in the design and analyses. The results help to better understand the behaviour of the backfill system, enabling engineers to optimize the paste backfill system design.

***Keywords*:** Shear strength, Stress-strain, Interfacial shear, Narrow wall, Arching

1. Introduction

The growing demand on mining products to improve and sustain human civilization had increase the numbers of mining activities around the world [1]. Mining is an activity to seek and extract profitable minerals embedded within the Earth's crust [2]. Due to the scarcity of minerals around the ground level, deep mining is the next challenge for the mining companies to maintain their profit margin [1], [3]. Underground ore extraction will create mined-out spaces (stopes) in forms of narrow rectangle with plan dimensions of 15-40m and heights of 50-100m and above [4], [5] that could reduce the ground stability and indirectly giving impact to ore recovery rate and safety issues [6]. Mining activities result in huge quantities of waste rock stockpiling and tailings impoundments [7].

Mine backfill is a new tailings management technique that utilise dewatered slurries as uncemented paste backfill (UCPB) or cemented paste backfill (CPB) to fill-up stopes for underground general stability [8]. The cemented paste backfill (CPB) is widely adopted in underground mining industry around the world due to its technical, environmental and economical strongpoints [2], [7]-[10]. CPB utilizes dewatered tailing waste, binding agent and water to create a free-flowing slurry-paste form to be filled into stopes and hardened as adjacent underground mine support [1], [4], [6], [9]. CPB mix proportion is usually in between of 3–7% by weight for binder and 70–85% by solid for tailings [11]-[14]. CPB has high water content with water cement ratio (w/c) between 2.5 and 7% that exceed the water needed for a completed hydration of cement. High w/c ratio is required in order to be able to pump the CPB through a pipeline without causing clog [15]. After backfilling, the weight of the backfill within the stope is not only transferred to the bottom of the stope but also transferred stope side walls. This phenomenon is known as arching effect [16]. When arching occurs in a filled stope, the vertical stress at the bottom of the fill is less than the overburden weight due to the horizontal transfer of stress to the side walls [16], [17]. This stress transfer is primarily associated with the frictional and/or cohesive interaction between CPB and stope sidewall [18].

The stability of CPB structures is a function of many factors, such as the mechanical properties of the CPB as well as the interfacial friction between the CPB and the sidewall. Researchers [3], [19] realised the importance of information on the shear strength parameter of CPB-stope wall and had conducted test on the interfacial friction angle between CPB and their rock samples. From common design practice, the internal friction angle of CPB is often used as the interfacial friction angle between CPB and rock because shear failure is not likely to occur at CPB-rock interface due to the high surface roughness of unevenly excavated wall [16], [19]-[21]. With the presence of significant pressure and heat, foliation of rock will occur and reduce the

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surface roughness and thus resulting in overestimation of the arching effect [22]. Consequently, overestimation will lead to failure and incur major loss.

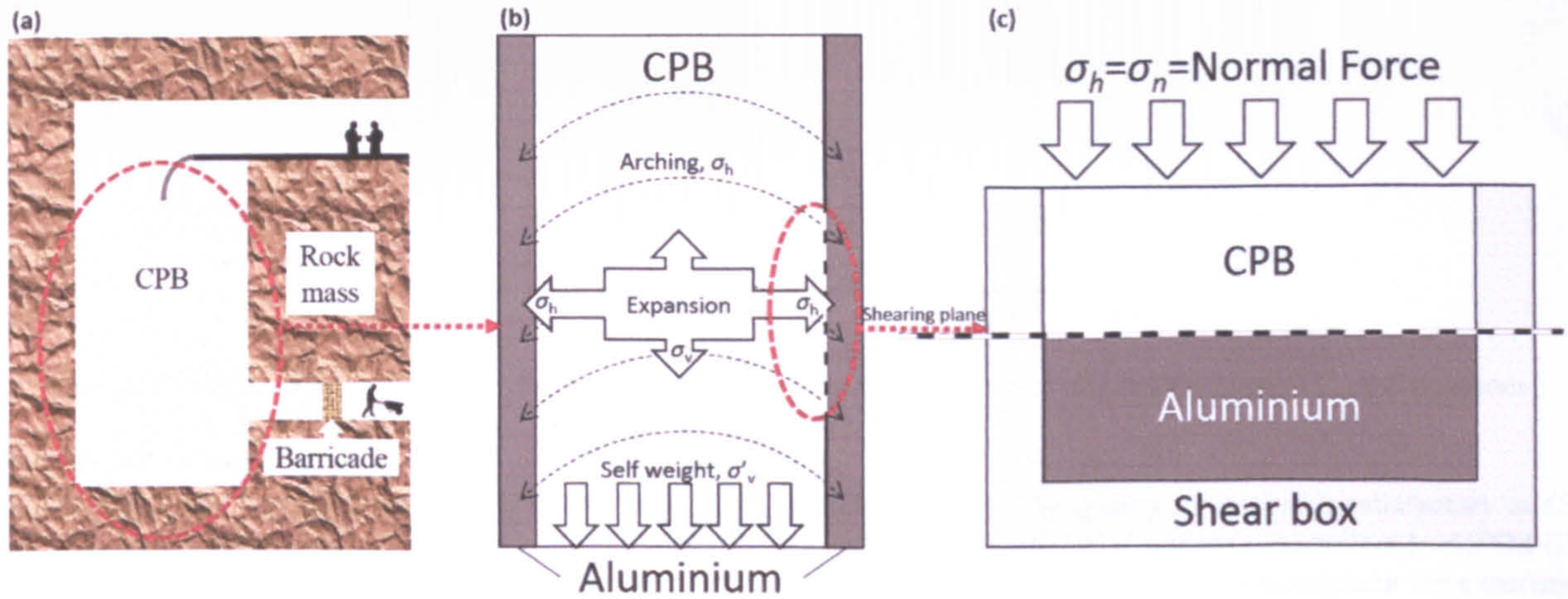

Figure 1 Schematic of (a) deposition of CPB into stope, (b) stress generate when deposited into aluminium narrow wall, (c) investigation of shear behaviour with direct shear test

To the best of the authors' knowledge, there are no data published on the interfacial friction between CPB deposition and aluminium wall in a laboratory scale model. Authors are developing a laboratory scale modelled narrow wall backfill system using aluminium as the materials to simulate the stope. Thus, the model requires validation if it can represent the stope with regards to the interfacial friction standpoint. Figure 1 shows the importance of interface shear properties of CPB-aluminium wall as a basic understanding on the behaviour of CPB when deposited into the model. In consideration of the facts that are mentioned above, a research program has been conducted at the University of Malaysia Sarawak to study the interfacial friction behaviour of the deposition of CPB into narrow wall. The main objectives of this paper are, to present the results of the experimental evaluation on the shear behaviour of CPB and interface friction behaviour corresponding to the aluminium wall under different shearing conditions, to develop a basic understanding of the shear behaviour of CPB-aluminium interface and, to correlate with the experiment on stress-strain CPB deposition within aluminium narrow wall.

2. MATERIALS

The CPB is reproduced in the laboratory by mixing fine silica flour, cement and water. The properties of these three materials are controlled and consistent in order to ensure reproducibility and repeatability of the results.

A. Silica flour as tailings

Silica flour is used as a replacement for tailings. Silica flour is a finely ground crystalline silica which mainly consist of SiO_2 is commercially obtained from SILVERBOND® Pasir Gudang, Johor, Malaysia. SILVERBOND® crystalline silica is produced from a high purity quartz with SiO_2 of 99.38% as shown in Table 1. The SILVERBOND® is inert, neutral in pH, and comes with a good consistency.

Table 1 Main chemical elements in SILVERBOND®

Element	Al	Ca	Si	Fe	Na	S	K	Mg	Ti
	wt.%	wt.%	wt.%	wt.%	wt.%	wt.%	wt.%	wt.%	wt.%
PG20	0.33	0.01	99.38	0.01	0.01	0.00	0.02	0.01	0.04

Researchers [3], [23]-[26] had used silica flour as tailing replacement on the research due to its benefits and its similarity of particle size towards tailing from the average of nine Canadian mine tailings. The particle size distribution of the ground silica used is shown in Figure 2. The particle mean diameter is 25μm. According to paste fill standard [27], the paste fill should contain at least 15% of passing with particle size of 20μm. Table 2 summarizes the physical properties of the silica flour. They were uniformly-graded with a coefficient of uniformity C_u of 3.66 and free of sulphide minerals. Sulphide will oxidise into sulphate and will affect the shear strength of CPB with its corresponding interface.

Table 2 Physical properties of SILVERBOND®

Parameter	G_s	D_{10}	D_{30}	D_{50}	D_{60}	D_{90}	C_u	C_c	Δ
Unit	-	μm	μm	μm	μm	μm	-	-	-
Value	2.67	8.2	17	25	30	56	3.66	1.17	1.91

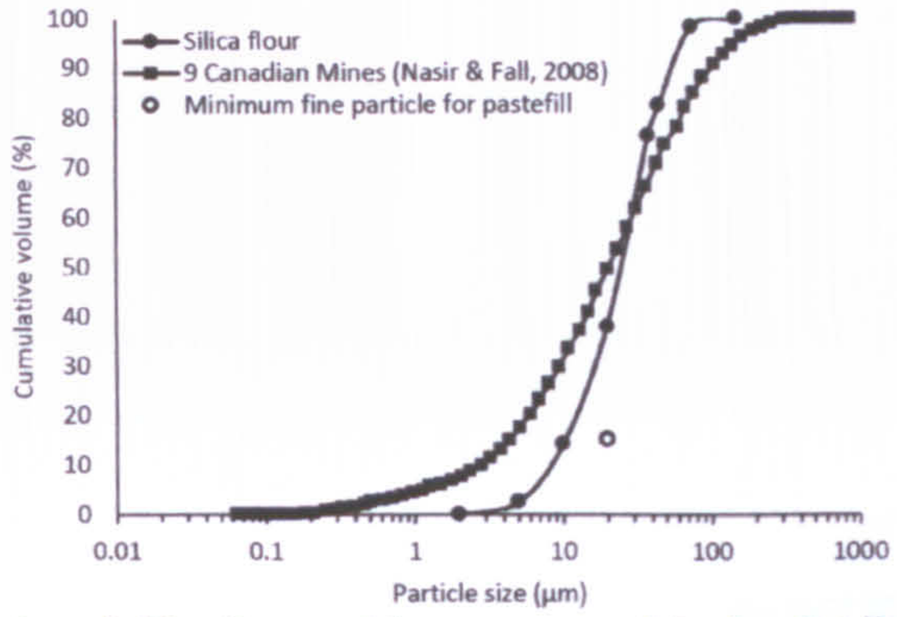

Figure 2 Particle size distribution of silica flour and the average particle size distribution from 9 Canadian mines

B. Portland cement as binder

Ordinary Portland cement is manufactured by Cahya Mata Sarawak (CMS). The quality of cement is satisfactory as CMS cement exceeds the standard requirement specified in Malaysian Standard MS EN 197-1 which is equivalent to ASTM C150 [28]. Amount of binder used is decided by the percentile of dry mass of tailing which is kept at 5% throughout the experiment.

$$B_w\% = \frac{M_B}{M_{Dry-T}} \quad (1)$$

where M_B is the mass of binder and $M_{Dry\text{-}T}$ is the mass of dry tailing.

C. Water

Clean consumable tap water supplied by Kuching Municipality Water Board is used for mixing in this experiment. The water is clean in terms of turbidity, pH, and chemical residual as claimed in their quality control standards [29]. The pH of the water is 6.84.

D. Aluminium platform

Aluminium plate of 60×60×5mm dimension was prepared by cutting from a bigger piece of aluminium plate using a shear cutter. The surface roughness is controlled by using new aluminium plate acquired from the same source. Aluminium plate used is incompressible under a range of applied pressures.

3. Specimen Preparation

The interface shear behaviour is studied by shearing UCPB and CPB with the aluminium plate. UCPB acts as a contrast to show the significance of binder on improving the properties of the paste. Brand new silica flour (from the bag) with initial water content less than 0.2% is used for the preparation of every type of specimen. Preliminary test such as slump test and UCS test are conducted to seek for the most suitable mix design for both UCPB and CPB as shown in Figure 3.

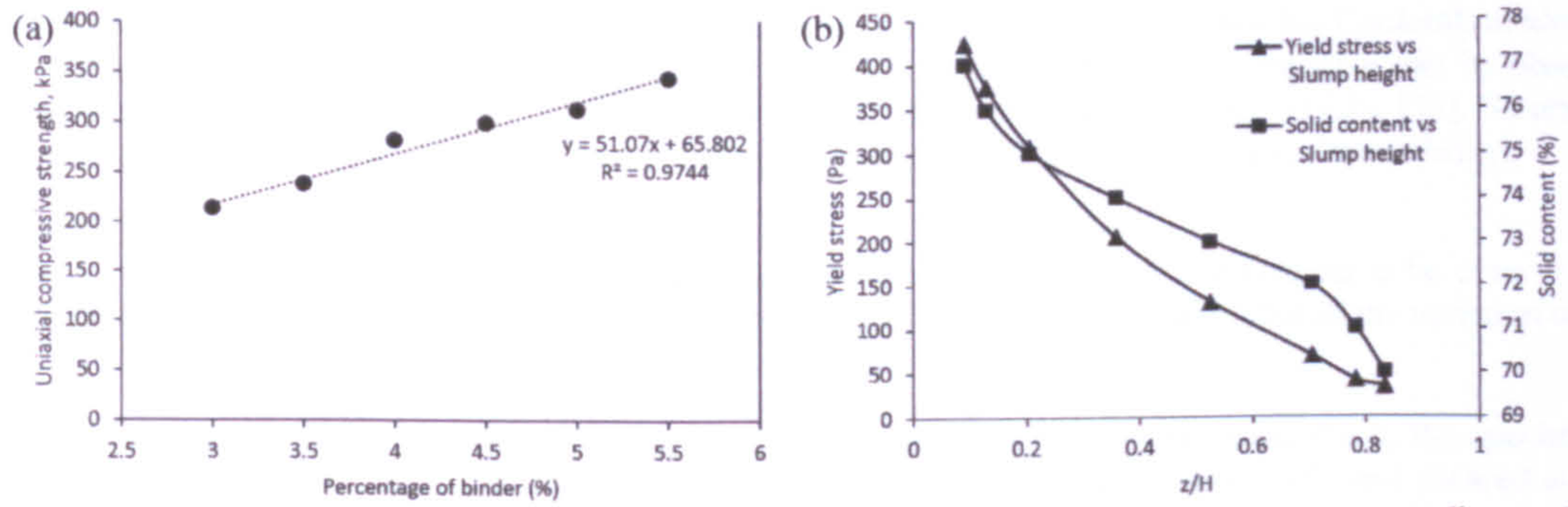

Figure 3 Graph showing (a) UCS value for different amount of binder used (b) Yield stress corresponding to the solid content (%) and slump height.

CPB has a common UCS application range of 0.2MPa to 5MPa but usually the target strength is 1MPa at 28 days and 0.3MPa at 3 days [1]. Researcher [30], [31] had showed the relative UCS value at different curing time where at 3 days of curing, the UCS strength should be around 0.3MPa. 5% of binder is required to obtain the UCS value of 0.3MPa. Slump tests were conducted with different solid content but the amount of binder is fixed at 5% due to UCS requirement. A range of dimensionless slump height (z/H) are obtained from a modified slump test namely fifty cent rheometer which allows yield stress identification [32]. Yield stress below 200Pa is recommended for a clog-free flow within a pipeline [33]. Thus, 72% solid content is selected for it only gives 115Pa of yield stress.

A. UCPB

UCPB sample is prepared as standard soil testing procedure for direct shear test according to ASTM D3080 [34].

B. CPB

CPB samples were prepared in three forms; cast in-situ for internal shear and interfacial shear and precast for interfacial shear. With the same mix composition of 72% solid content, 5% of cement by weight and water-cement ratio of 7.7 as shown in Table 3 were used to prepare for all CPB specimen. The amount of binder and days of curing is fixed as it has insignificant effects towards the interface shear strength [19]. The materials are mixed until homogenous within dissolution stage of hydration process. The mixture is cast into the direct shear box as a mould to prepare the precast CPB. As for cast in situ CPB, it is poured directly into an assembled direct shear box with an aluminium surface levelled with the shearing plane as shown in Figure 4. Minor gaps between the square aluminium plate and the direct shear box is filled with silicon sealant to avoid the formation of griping mechanism. Excess silicon sealant will be removed as it will interfere with the shearing surface. The CPB sample is cured under high humidity by curing it for 3 days in an enclosed basin with the presence of thin water layer below the sample. For saturated test, CPB after 2 days curing will be cured under saturated condition for 1 day.

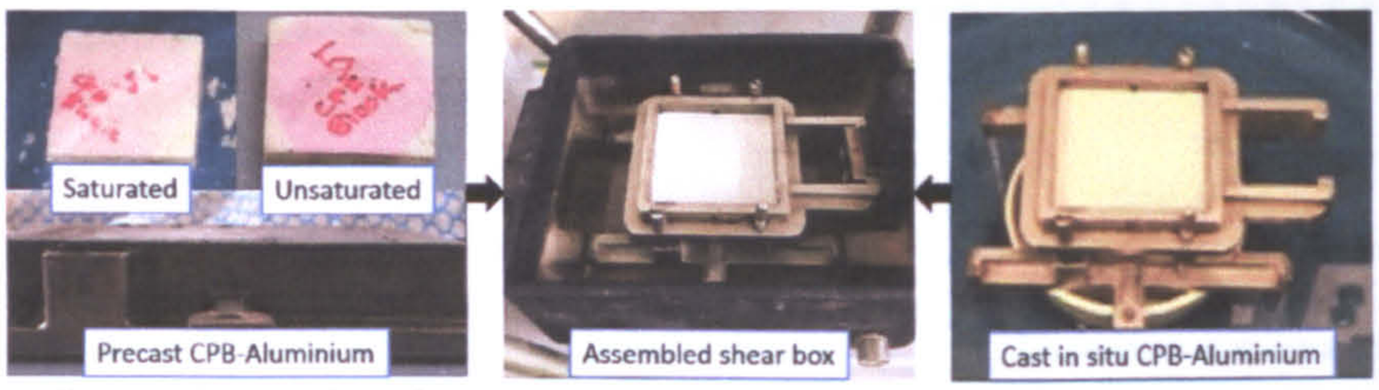

Figure 4 Preparation of CPB specimen prior testing with direct shear apparatus.

Table 3 Specimen mixture characteristic

Specimen	Binder content, B_w (%)	Solid mass content, C_w (%)	Water content (out of total), w_T (%)	Water content (out of solid), w_S (%)	Water to cement ratio, w/c	Slump height, S (mm)	UCS (kPa) 3d	Yield stress (Pa)
UCPB	0	72	28	38.9	-	21	48	70
CPB	5	72	28	38.9	7.7	17	314	115

4. EXPERIMENTAL PROGRAM

A. Experimental approaches

This direct shear test is conducted to correlate with an experimental investigation of UCPB and CPB deposition. By referring to Figure 1, as the deposition takes place within a narrow wall, vertical stress will be transferred to the side wall due to arching. Heating from the cement hydration contribute to the expansion and thus, arching is intensified. Expected thermal expansion and arching effect of the specimen towards the aluminium side wall behaves like a normal force contributing towards the interface shear plane. Normal stress applied in the direct shear test is back calculated from the condition of backfill within the narrow wall without any overburden stress (i.e. only self-weight). The self-weight of UCPB and CPB deposition is equivalent to 16kN/m^2 of normal force applied onto a direct shear sample. In order to develop to fit into the Coulomb model, the direct shear test is conducted in three normal stresses: 16kN/m^2, 32kN/m^2 and 48kN/m^2. No deformation can be observed if the normal stress applied to CPB that is cured for 3 days with 5% binder content is less than 100kPa [35]. Saturation of the specimen is also concerned as excess water is present during deposition due to the requirement of workability.

B. Direct shear apparatus

ELE International digital direct shear apparatus is used for the testing. It allows the modification to be done to investigate the interfacial friction behaviour. Rapid shear box test conforming ASTM D3080 is conducted for all the variation of specimen.

C. Test procedure

The specimen is assembled in a way that fulfil the experiments in Table 4. For interfacial shear, the specimen and the aluminium surface had to be exactly at the shearing plane. Normal stress is applied accordingly and sheared at the rate of 1mm/min until 15% shear strain is archived. Aforementioned shear rate is selected based on ASTM3080 and explained as follows. The longest time required for UCPB samples to archive 90% consolidation is 0.5min as CPB takes less time than UCPB. The total estimated elapsed time for failure is 5.8min and the horizontal displacement at failure is at 6mm. Thus, the maximum displacement rate suitable for these experiment is 1.03mm/min and below. All data were recorded manually.

D. Test plan

Dry silica flour, saturated silica flour and interfacial shearing between saturated silica flour and aluminium with different initial density was investigated under UCPB category.

Table 4 Test plan for direct shear test

Specimen	UCPB				CPB					
	Dry		Saturated		Dry			Saturated		
Shearing condition	UC-UC	UC-A	UC-UC	UC-A	C-C	CC-A	PC-A	C-C	CC-A	PC-A

*Note that UC is UCPB, C is CPB, CC is cast in situ CPB, PC is precast CPB and A is aluminium.

5. Result and Discussion

The direct shear results are presented in terms of shear stress-strain, and Mohr-Coulomb envelope that shows cohesion/adhesion and friction angle parameter. Data obtained on the deformation behaviour of specimen under different shearing condition are beyond the scope of this paper. The shear stress-strain curves of UCPB and CPB are shown in Figure 5 and Figure 6. Generally, two types of curve can be observed which are nearly perfect plateau elastoplastic curve (Figure 5a, b, and Figure 6) and elastoplastic curve with strain hardening (Figure 5c and d).

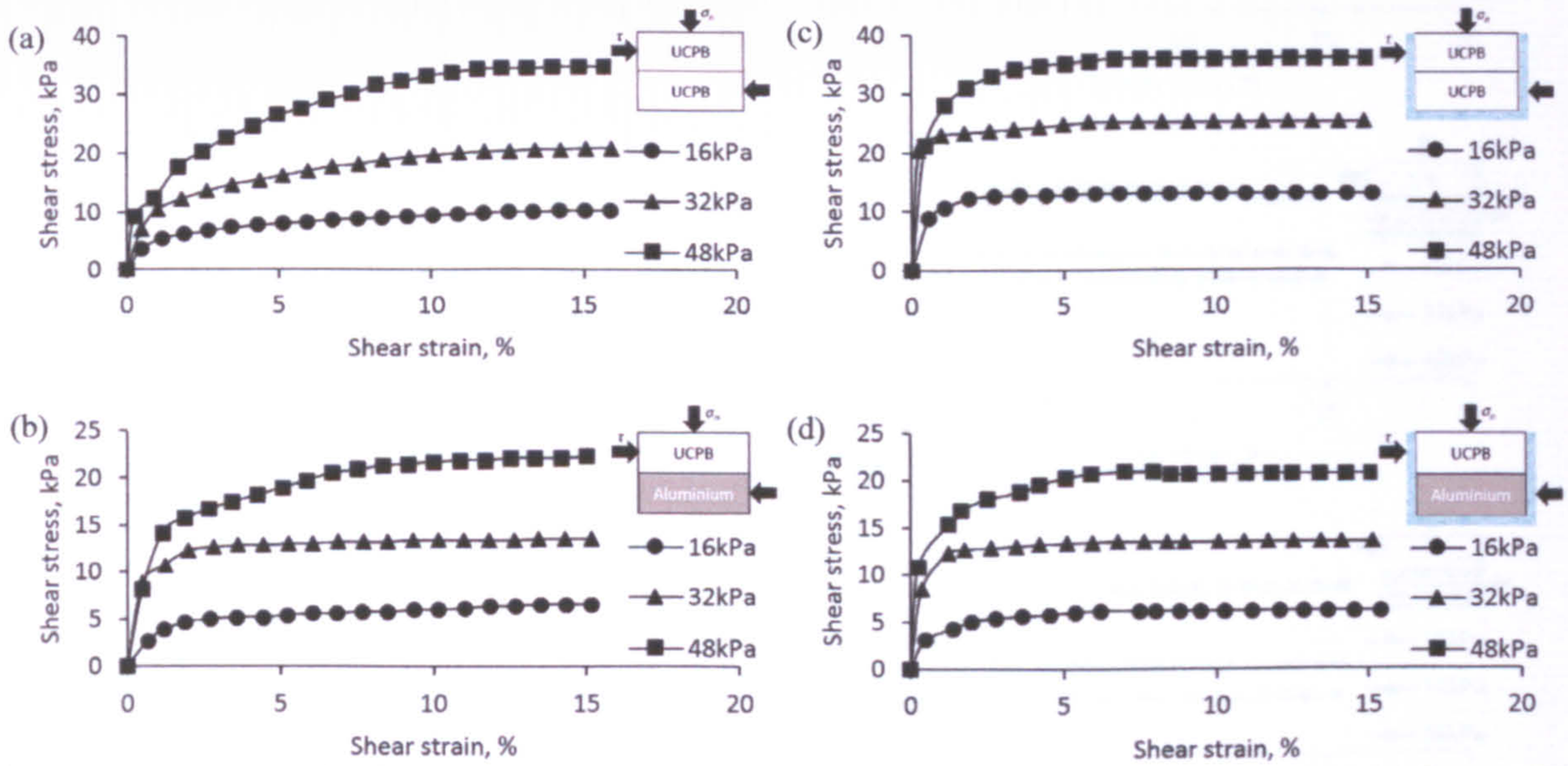

Figure 5: Shear stress-strain of UCPB under different shearing condition. (a) Dry UC-UC (b) Dry UC-A (c) Saturated UC-UC (d) Saturated UC-A

Each test in Figure 5 are investigated under different density but only the one initial packing of 1.75g/cm^3 are discussed in this paper because it correlates with the density of the mix design for UCPB and CPB used. Figure 5a and b show the internal shear stress-strain behaviour of dry silica flour and interface shear stress-strain behaviour of dry silica flour with aluminium surface with no presence of water for saturation whereas Figure 5c and d are sheared under a saturated condition. Specimens in Figure 5a and b behaves like a fine granular remoulded sample. Shear stress-strain behaviour of remoulded specimen normally behaves like elastoplastic curve with strain hardening where peak stress is not presented as overconsolidated. The internal shear stress of UC-UC is greater than UC-A interface by 56.0%, 53.4% and 51.0% with respect to the normal stress of 16kPa, 32kPa and 48kPa. When saturated, the silica flour appears to behave like a block of paste although no cement binder is added. The greater initial gain as shown in Figure 5c, d in shear stress compared to dry silica flour is partly due to the formation of minor cohesion within UCPB and adhesion between of UCPB and aluminium surface. After overcoming the shear strength from the adhesive/cohesive behaviour, lubrication effect due to the presence of water will generally reduce the friction and thus resulting in minor gain in shear stress after 2% shear strain. The ultimate shear strength for saturated case is slightly higher due to the minor adhesion/cohesion.

Figure 6a-c show the internal shear stress-strain behaviour of CPB and interface shear stress-strain behaviour of CPB-aluminium under different casting method whereas Figure 6d-f show the same tests but under saturated condition. Binder content and curing time is kept to be the same throughout the tests since the interface shear stress-strain behaviour is significantly affected by binder content if the shearing occurred within CPB and within a cast in situ CPB-aluminium interface shear [3] although it has been established that the interface shear stress-strain behaviour is insignificantly affected by binder content and even less affected by curing time [19]. Figure 6c and f shows similar shear stress-strain behaviour as Figure 5b and d but possess higher shear stress throughout the shearing. Similar behaviour may be due to the same contact in between specimen and aluminium but the difference in shear stress value is most likely due to the greater surface roughness of CPB compared to UCPB which is rather soft and does not have the ability to control its surface roughness. The interface shear stress of precast CPB and aluminium does not varies much from each other due to the counterbalance effect as mentioned in UCPB-aluminium interface.

Figure 6a, b, d and e show shear stress-strain behaviour in between of CPB-CPB and CPB-aluminium interface under saturated and unsaturated condition. First peak shear stress can be seen at region less than 3% shear strain for both unsaturated and saturated CPB-aluminium interface which is due to the failure of the cementation bond between CPB-aluminium interface. This is supported by post-shear observation where a very thin frictional layer of CPB remains on the aluminium surface. It is confirmed that there is bonding in between cast in situ CPB as the layer cannot be easily removed from the surface of aluminium. After the peak shear stress, the shear stress remains or slightly increase beyond 3% shear strain. For CPB-CPB shear, shear stress had reached its peak at around 1% shear strain then it remains or slightly increase for the rest of the shearing. The internal shearing of CPB possess the highest shear strength regardless the saturation condition then followed by cast in situ CPB-aluminium interface and finally precast CPB-aluminium interface is the weakest in terms of shear strength. The effects of saturation on the shear strength CPB is insignificant but to some extent it affects the friction angle and cohesion.

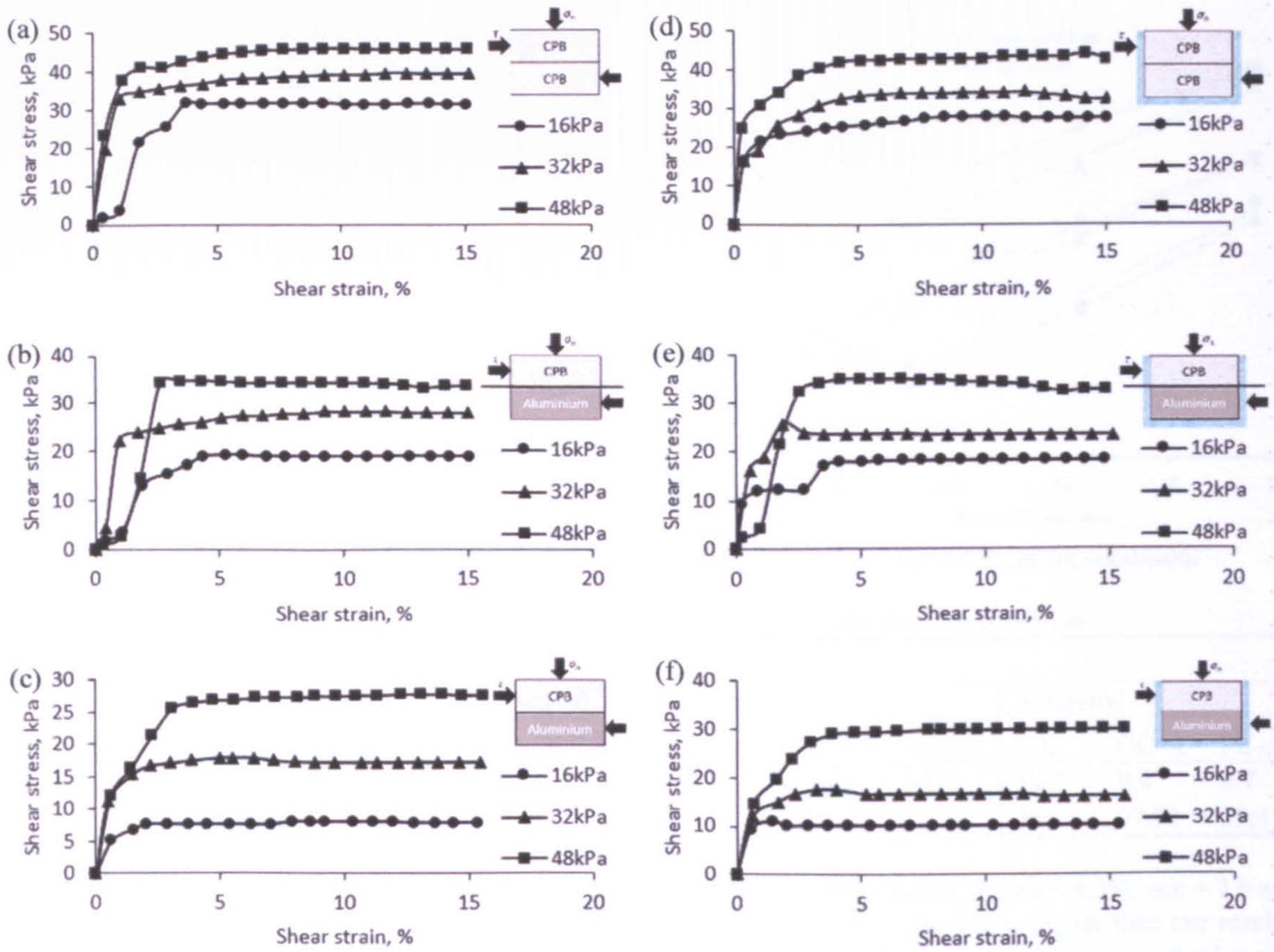

Figure 6 Shear stress-strain of CPB under different shearing condition (a) Dry C-C (b) Dry CC-A (c) Dry PC-A (d) Saturated C-C (e) Saturated CC-A (f) Saturated PC-A

Figure 7 shows the Mohr-Coulomb envelope of UCPB and CPB under different shearing condition and Table 5 shows the cohesion and friction angle obtained from Figure 7. These envelopes were produced by fitting a linear regression line for each dataset and for all regression line was more than 0.967. Every shear failure envelope obeyed the Mohr-Coulomb failure criterion where the increase in shear stress is linear to the normal stress induced. Friction angle (φ) and cohesion (c) under our range of normal stress (σ_n) was obtained from (2).

$$\tau = c + \sigma_n \tan(\varphi) \quad (2)$$

where τ is the shear stress.

It is expected that there should not have any cohesion for cases other than CPB-CPB and cast in situ CPB-aluminium. Cohesion obtained in the range of -2.7kPa to 1.8kPa are obtained as results of curve fitting. Hypothesis was made to explain these small deviations by understanding the shearing condition and the trend of the cohesion value. As mentioned before, saturated shearing condition have the tendency to create a paste-like block where a minor adhesive behaviour will be created in between the material itself and towards another surface. It is notable from the UCPB Mohr-Coulomb envelope that the minor cohesion created is higher when the specimen is saturated and the adhesive is greater in between of the paste-like material itself rather than in between UCPB-aluminium interface. Minor adhesion as discussed in saturated UCPB specimens is lesser at saturated precast CPB as the particles of CPB have a greater tendency to be bonded and remained within CPB itself rather than creating a minor adhesive effect by sticking to the aluminium surface like UCPB did. Though a cohesion of 0.7kPa is still observed because the surface of CPB is slightly dissolved due to saturation and hence some of the soften parts behaves like paste and thus creating a lesser adhesive behaviour compared to saturated UCPB. The cohesion obtained from CPB-CPB shearing is greater than the adhesion obtained from cast in situ CPB-aluminium interface shear by 110.2% for unsaturated condition and 104.3% for saturated condition. Aforementioned specimen at unsaturated condition generally have higher cohesion than saturated condition. The presence of water can promote minor adhesion to non-cohesive material but at the same time it will also reduce the bonding strength of CPB and thus reducing the cohesion value.

The friction angle of the UCPB material are tested under different initial density. The internal friction angle of UCPB is in between of 27.85° to 37.45° and interfacial friction angle of UCPB is in between of 23.20° to 26.13°. The highest friction angle for all cases of UCPB shearing are shown in Table 5. The friction angle of unsaturated UCPB is greater than saturated UCPB by 5%. Such reduction in friction angle is due to the lubrication effect between water and particles. The friction angle of UCPB-aluminium interface is significantly lower due to the smooth surface of aluminium platform. The friction angle of precast CPB-aluminium interface is higher than UCPB-aluminium interface as the surface roughness of CPB is higher than UCPB. The friction angle of the specimens with cohesion is affected by the high initial shear stress due to cementation bond. Thus, showing less shear stress gain from the variation of normal stress applied and reduces the friction angle of the material upon obeying the linear law of Mohr-Coulomb envelope. As the CPB is sheared under a saturated condition, the reduction of bonding strength/cohesion of CPB will gives a higher friction angle value.

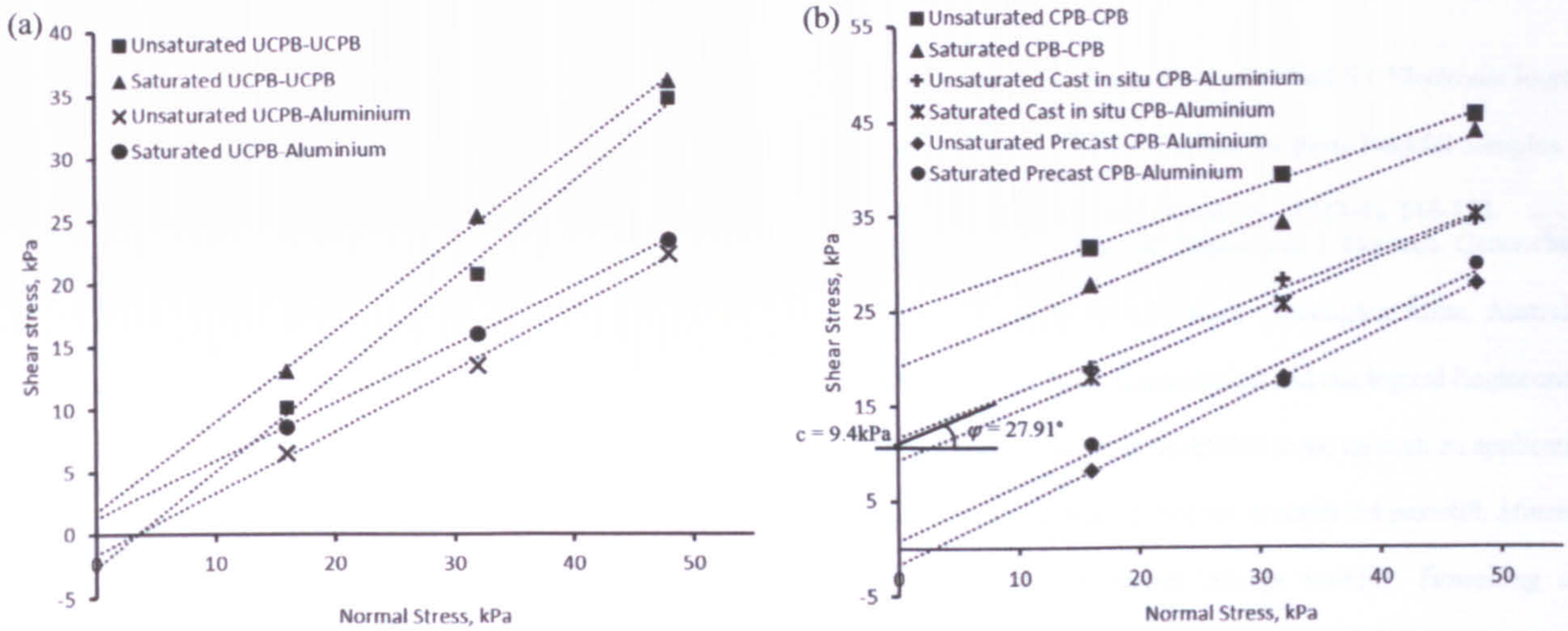

Figure 7 Mohr-Coulomb envelope of (a) UCPB and (b) CPB under different shearing condition.

Table 5 Specimen cohesion and friction angle under each shearing condition

Specimen	UCPB				CPB					
	Dry		Saturated		Dry			Saturated		
Shearing condition	UC-UC	UC-A	UC-UC	UC-A	C-C	CC-A	PC-A	C-C	CC-A	PC-A
Cohesion (kPa)	-2.7	-1.6	1.8	1.2	24.8	11.8	-1.7	19.2	9.4	0.7
Friction angle (°)	37.45	26.13	35.68	24.73	23.83	25.96	31.60	26.94	27.91	30.47

Researcher [3] shows the interfacial friction angle and adhesion of cast in situ CPB (dry, binder = 4.5%, w/c = 7.6 and cured at 3 days) and smooth limestone rock were found to be 24.78° and 27.06kPa. The adhesion is higher than our results as the surface roughness of aluminium is smoother than the rock that are claimed to be smooth. Formation of minor gripping mechanism due to hardening of CPB is more significant at rougher surface. As the bonding failed due to shearing, the surface of the aluminium and limestone (compressive strength of 27MPa) is not likely to be damaged whereas CPB failed and form a thin and evenly distributed layer of CPB on aluminium surfaces and [3] rock surfaces. Thus, the shearing occurs between CPB and the thin layer of CPB on the surface of other material so the interfacial friction angle is similar. Researcher [19] shows the interfacial friction angle and adhesion between precast CPB and smooth granite rock were 38° and 8kPa respectively. The rather soft behaviour of CPB (4.5% binder and 3 days of curing) will deform at 100kPa applied pressure and above [35]. Researcher [19] applied up to 200kPa of normal stress on CPB sample which have the tendency to cause deformation and takes shape of the surface roughness of the granite used. Thus, some shear strength required to break the bonding formed due to deformation of CPB. The surface of aluminium is smoother than granite so the resulting interfacial friction angle is lower.

6. CONCLUSION

The paper presents the experimental results on the interfacial friction between backfill material and the aluminium narrow wall system as well as the internal friction of the paste backfill. This study explains the shear stress-strain behaviour of the internal and interfacial friction of the backfill system. The values shear strength, cohesion, and friction angle and some comparisons are reported. A thorough analysis is made on each dataset obtained then the following conclusion can be drawn:

- The shear failure envelopes both internal and interfacial tests fit Mohr -Coulomb failure criterion.
- The presence of water can alter the final shear strength depending on initial material condition.
- The interfacial friction angle of CPB-A is higher than shear strength of CPB-CPB shearing by a factor of 1.06.
- The interfacial friction angle of UCPB-A is lower than shear strength of UCPB-UCPB shearing by a factor of 0.69.
- The interface shear behaviour for both cast in situ and precast CPB-A are comparable with previous finding on interface shear behaviour of cast in situ and precast CPB-rock.

Data that are presented in this paper will be useful for the understanding of stress distribution of CPB within aluminium narrow wall in simulating the CPB – rock wall behaviour in real stopes. Sufficient shear strength at the interface might be able to reduce vertical stress generation from volumetric thermal expansion.

ACKNOWLEDGMENT

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REFERENCES

[1] Sheshpari, M. (2015). A review of underground mine backfilling methods with emphasis on cemented paste backfill. Electronic Journal of Geotechnical Engineering, 20(13), 5183-5208.
[2] Yilmaz, E., Kesimal, A., Ercikdi, B., & Alp, I. (2003). Determination of the Optimum Cement Content for Paste Backfill Samples. In 18"' International Mining Congress and Exhibition of -IMCET 2003 (pp. 119-125). Turkey.
[3] Nasir, O., & Fall, M. (2008). Shear behaviour of cemented pastefill-rock interfaces. Engineering Geology, 101(3-4), 146-153.
[4] Helinski, M., Fahey, M., & Fourie, A. (2007). Numerical Modeling of Cemented Mine Backfill Deposition. J. Geotech. Geoenviron. Eng, 133(10), 1308-1319.
[5] Rankine, R. M., & Sivakugan, N. (2007). Geotechnical properties of cemented paste backfill from Cannington Mine, Australia. Geotechnical and Geological Engineering, 25(4), 383-393.
[6] Ghirian, A., & Fall, M. (2015). Coupled Behavior of Cemented Paste Backfill at Early Ages. Geotechnical and Geological Engineering, 33(5), 1141-1166.
[7] Li, L., & Yang, P. (2015). A numerical evaluation of continuous backfilling in cemented paste backfilled stope through an application of wick drains. International Journal of Mining Science and Technology, 25(6), 897-904.
[8] Benzaazoua, M., Fall, M., & Belem, T. (2004). A contribution to understanding the hardening process of cemented pastefill. *Minerals Engineering*, *17*(2), 141-152.
[9] Fall, M., Benzaazoua, M., & Saa, E. (2008). Mix proportioning of underground cemented tailings backfill. *Tunnelling and Underground Space Technology*, *23*(1), 80-90.
[10] Belem, T., Benzaazoua, M., Bussière, B., & Dagenais, A. M. (2002). Effects of settlement and drainage on strength development within mine paste backfill. *Tailings and Mine Waste '02. Sets & Zeitlinger*, 139-148.
[11] Landriault, D.A., 1995. Paste backfill mix design for Canadian underground hard rock mining. *In: Proc. of the 97th Annual General Meeting of the CIM Rock Mechanics and Strata Control Session*, Halifax, Nova Scotia.
[12] Orejarena, L., & Fall, M. (2008). Mechanical response of a mine composite material to extreme heat. *Bull Eng Geol Environ*, *67*(3), 387-396.
[13] Orejarena, L., and M. Fall 2011. Artificial neural network based modelling of the coupled effects so sulphate and temperature on the strength of cemented paste backfill. *Canadian Journal of Civil Engineering* 38:100-109. 9.
[14] Nasir, O., & Fall, M. (2009). Modeling the heat development in hydrating CPB structures. *Computers and Geotechnics*, *36*(7), 1207-1218.
[15] Ramlochan, T., Grabinsky, M., & Hooton, R. (2004). Microstructural and chemical investigations of cemented paste backfills. *Paper presented at the The 57th Canadian geotechnical conference*, Quebec City.
[16] Terzaghi, K. (1943). Arching in Ideal Soil. In *Theoretical soil mechanics*. New York: J. Wiley and Sons, Inc.
[17] Marston, A. 1930. The theory of external loads on closed conduits in the light of latest experiments. *Bulletin No. 96*, Iowa Engineering Experiment Station, Ames, Iowa.
[18] Belem, T., & Benzaazoua, M. (2008). Design and Application of Underground Mine Paste Backfill Technology. *Geotechnical and Geological Engineering*, *26*(2), 147-174.
[19] Koupouli, N. J., Belem, T., Rivard, P., & Effenguet, H. (2016). Direct shear tests on cemented paste backfill–rock wall and cemented paste backfill–backfill interfaces. Journal of Rock Mechanics and Geotechnical Engineering, 8(4), 472-479.
[20] Li, L., Aubertin, M., Simon, R., Bussière, B., & Belem, T. (2003). Modeling arching effects in narrow backfilled stopes with FLAC. In *In: Proceedings of 3rd international FLAC symposium* (pp. 211-218).
[21] Pierce, M.E., 2001. Stability analysis of paste backfill exposures at Brunswick Mine. Proceedings of 2nd international FLAC Symposium. Lyon, France.
[22] Mitchell, R.J., Olsen, R.S., Smith, J.D., 1982. Model studies on cemented tailings used in mine backfill. Canadian Geotechnical Journal 19 (1), 14–28.
[23] Ghirian, A., & Fall, M. (2013). Coupled thermo-hydro-mechanical–chemical behaviour of cemented paste backfill in column experiments. Part I: Physical, hydraulic and thermal processes and characteristics. *Engineering Geology*, *164*, 195-207.
[24] Fall, M., Célestin, J., Pokharel, M., & Touré, M. (2010). A contribution to understanding the effects of curing temperature on the mechanical properties of mine cemented tailings backfill. *Engineering Geology*, *114*(3-4), 397-413.
[25] Fall, M., & Pokharel, M. (2010). Coupled effects of sulphate and temperature on the strength development of cemented tailings backfills: Portland cement-paste backfill. *Cement and Concrete Composites*, *32*(10), 819-828.
[26] Abdul-Hussain, N., & Fall, M. (2012). Thermo-hydro-mechanical behaviour of sodium silicate-cemented paste tailings in column experiments. *Tunnelling and Underground Space Technology*, *29*, 85-93.
[27] Potvin, Y., Thomas, E., Fourie, A. (2005). Handbook on mine fill: Australian Centre for Geomechanics.
[28] Malaysia, Cahya Mata Sarawak (1998) [Web log post]. Retrieved April 8, 2017, from http://cement.cmsb.com.my/?page_id=8197
[29] Malaysia, Kuching Water Board (2000) [Web log post]. Retrieved April 8, 2017, from http://www.kwb.gov.my/modules/web/pages.php?mod=webpage&sub=page&id=75
[30] Ghirian, A., & Fall, M. (2016). Strength evolution and deformation behaviour of cemented paste backfill at early ages: Effect of curing stress, filling strategy and drainage. *International Journal of Mining Science and Technology*, *26*(5), 809-817
[31] Wu, A., Wang, Y., Zhou, B., & Shen, J. (2016). Effect of Initial Backfill Temperature on the Deformation Behavior of Early Age Cemented Paste Backfill That Contains Sodium Silicate. *Advances in Materials Science and Engineering*, *2016*, 1-10. doi:10.1155/2016/8481090
[32] Pashias, N., Bogera, D. V., Summers, J., Glenister, D. J. (1996). A fifty cent rheometer for yield stress measurement. *Journal of Rheology 40(6):* 1179-1189.
[33] Cooke, R., (2008). Pipeline design for paste and thickened tailings systems. *Tailings and Mine Waste '08. Taylor & Francis Group*, 95-100.
[34] ASTM D3080 (2011) Standard Test method for direct shear test of soils under consolidated drained conditions. ASTM International, West Conshohocken. www.astm.org
[35] Yilmaz, E., Belem, T., Bussiere, B., Benzaazoua, M., (2008) Consolidation characteristics of early age cemented paste backfill. In *Proceedings of the 61 st Canadian Geotechnical Conference,* Edmonton, Alberta, Canada, September 21-24, pp. 797-804.

ENCON2017 TECHNICAL PARALLEL SESSION 1

13th September 2017 (Wednesday)

TIME	Parallel Sessions			
	Danum 2 ChE Prof. Dr Hj. Mohammad Omar Abdullah	**Danum 3 CE 1 Prof. Dr Ng Chee Khoon**	**Danum 4 EE 1 Prof. Dr Musse Mohamud Ahmed**	**Danum 5 ME 1 Prof. Dr Shahidul**
1400 1420	D2-P01 **Eugene Jackson Joy (107)** *Effects Of Hydraulic Retention Time And Solid Retention Time Of POME On COD Removal Efficiency*	D3-P01 **Hamidun Bin Mohd Noh (93)** *Impact Of Cover/Bar Diameter Ratio To The Structural Performance Of Reinforced Concrete Member Due To Corrosion*	D4-P01 **Yonis. M. Yonis Buswig (36)** Voltage Tracking Of A Multi-Input Interleaved Buck-Boost DC-DC Converter Using Artificial Neural Network Control	D5-P01 **Handie Ahmataku (90)** *Analysis Of Gate Poly Delayering In SOI Wafer*
1420 1440	D2-P02 **Khairul Anwar Mohamad Said (20)** *The Relationship Of Silver Content On Water Flux Of Polysulfone Composite Membrane*	D3-P02 **Mohd Rashdan Saad (69)** *The Role Of Building Layout In Haze Reduction*	D4-P02 **Siti Kudnie Sahari (70)** *Surface Analysis Of Thermally Growth Ge Oxide On Ge(100)*	D5-P02 **Nurfalruz Nadirah Affandi (21)** *Multiple-Objective Optimization Techniques In Laser Joining/Welding Of Dissimilar Materials Classes: A Comparison Between Grey And Ratio Analyses*
1440 1500	D2-P03 **Tausif Ahmad (76)** *Study On Effect Of Volume Of Gold Choloroauric Acid On Size, Shape And Stability Of Biosynthesized Gold Nanoparticles Using Aqueous Elaeis Guineensis (Oil Palm) Leaves Extract*	D3-P03 **Mohamad Tazuddin Adrus (2)** *Collaborative Location-Based Mobile Game With Error Detection Algorithm*	D4-P03 **Erdawaty Mohd Jaafar (35)** *Study Of Morphology, Optical And Electrical Properties Of Graphene Oxide Thin Film Depends On The Reaction Time Of Synthesis*	D5-P03 **Wong Wei Kitt (12)** *Euclidean Space Data Projection Classifier With Cartesian Genetic Programming (CGP*
1500 1520	D2-P04 **Loi Hoang Huy Phuoc Pham (15)** *Simulation Analysis Of Initial CO2 Bubble Formation In Seawater Using VOF Method*	D3-P04 **Nurul Syakeera Nordin (26)** *Evolution Of Shear Strength With Varying Cement Dosages In Dredged Marine Soils*	D4-P04 **Muhammad Mujahid Muhammad (101)** *Artificial Neural Network Applications For Predicting Drag Coefficient In Flexible Vegetated Channels*	D5-P04 **Shahriar Shams, (53)** *Challenges And Opportunities Of Green Roof In Building Design: A Case Study From Bandar Seri Begawan*
1520 1540	**Evening Tea Break Venue: Foyer**			
1540 1600	D2-P05 **Muhammad Mubashir (97)** *Enhanced Gases Separation Of Cellulose Acetate (CA) Membrane Using N-Methyl-2-Pyrrolidone As Fabrication Solvent*	D3-P05 **Ding Sie Hao (85)** *Synthesis Of KIT-6 Silica And Preparation Of Mixed Matrix Membranes By Incorporating KIT-6 Into Cellulose Acetate Membrane*	D4-P05 **Dyg Norkhairunnisa Abang Zaidel (58)** *Design And Analysis Of Slotted Ring Wideband Bandpass Filter For Microwave Sensor To Measure Rice Quality*	D5-P05 **Mahshuri Yusof (75)** *Tensile Properties Of Clam Shell Powder-Filled Unsaturated Polyester Composites*
1600 1620	D2-P06 **Nurul Aini Amran (57)** *Effect Of Freezing Time And Shaking Speed On The Performance Of Progressive Freeze Concentration Via Vertical Finned Crystallizer*	D3-P06 **Siti Farhanah S.M Johan (28)** Effect Of Granular Inclusion On The Consolidation Rate Of Dredged Marine Clay	D4-P06 **Law Kah Haw (45)** *Lead Compensator Design For Single-Phase Quasi Z-Source Inverter*	D5-P06 **Javed Akhter (77)** *Design And Optical Modeling Of A Low Profile Stationary Concentrating Solar Collector For Medium Temperature Heat Supply*
1620 1640	D2-P07 **Umair Sikander (18)** *Effects Of Catalyst Bed Position On Hydrogen Production By Methane Decomposition*	D3-P07 **Suraya Hani Adnan (13)** *Additional Of Cement Leftover From The Hollow Of The Spun Pile Reinforcement As An Additive To Scc*	D4-P07 **Ma Quanjin (38)** *Design Of Portable 3-Axis Filament Winding Machine With Inexpensive Control System*	D5-P07 **Siti Hawa Nabilah Zahari (19)** *Minimum Ignition Energy Of Engineered Nanomaterials (Enms)*
1640 1700	D2-P08 **Muhammad Athar,(72)** *Integrated Safety And Process Optimization Approach For Ammonia Synthesis Loop*	D3-P08 **Nurasiah Mira Anuar (24)** *Passive Pathogenic Removal In Leachate: Monitoring Of E. Coli Count*	D4-P08 **Mohd Hafiez Izzwan (113)** *Water Tree Simulation On Underground Polymeric Cable Using Finite Element Method For Research Purpose*	D5-P08 **Hilton Ahmad (86)** *Multi-Holes Configurations Of Woven Fabric Kenaf Composite Plates: Experimental Works And 2-D Modelling*

ENCON2017 TECHNICAL PARALLEL SESSION 2

14th September 2017 (Thursday)

TIME	Parallel sessions			
	Danum 2 CE 1 Assoc. Prof. Ir. Dr Siti Noor Linda Taib	**Danum 3 EE 1 Assoc. Prof. Dr Hushairi Zen**	**Danum 4 ME 1 Assoc. Prof. Dr Syed Tarmizi Syed Shazali**	**Danum 5 ChE Assoc. Prof. Dr Cirilo Nolasco**
0830 0850	D2-P09 **Nasser Rostam Afshar (46)** *Impact Of Climate Change To Water Resources*	D3-P09 **Sim Sy Yi (33)** *Power Factor Improvement In Power System With The Integration Of Renewable Energy*	D4-P09 **Muhamad Mat Noor (98)** *Performance, And Emission Characteristics Of Single Cylinder CI Engine Operated With Fusel Oil – Diesel Blend*	D5-P09 **Atta Ullah (4)** *An EMMS Mixture Model With Bubble Size Distribution*
0850 0910	D2-P10 **Alvin John Lim (43)** *Relationship Between Undrained Shear Strength (Su) And Consolidation Ratio For Cohesive Soil (Marine Clay)*	D3-P10 **Falih Alkhafaji (40)** *Proposed Optimisation Proportional Integral Derivative Controller Based On Second And Third Plant Model*	D4-P10 **Charlie Sia Chin Voon (25)** *Weibull Analysis On Banana Fiber Strength With Variation Of Within Fiber Cross-Sectional Area*	D5-P10
SUPERVISOR ATTENDED 0910 0930	D2-P11 DR BISDAI HASAN **Ting Wee Kiet (23)** *Interfacial Friction Behaviour In Narrow Wall Paste Backfill System*	D3-P11 **Nasir Shehzad (89)** *Graphene Oxide As An Efficient Photocatalyst For Photocatalytic Reduction Of CO2 Into Solar Fuel*	D4-P11 **Melissa Augustine Saidi (30)** *The Optimum Sodium Hydroxide Concentration For High Strength PLA-Rice Straw Composites*	D5-P11 **Muhammad Syafiq Hazwan Ruslan (29)** *Kinetic Model Of Supercritical Fluid Extraction Of Areca Catechu (Betel Nut)*
0930 0950	D2-P12 **Jeffrey Yap Boon Hui (5)** *Managing Design Change Dynamics In Building Construction: Conceptualising A Qualitative Model*	D3-P12 **Dayang Siti Amira Awang Yusuf (95)** *Design Of CMOS Power Amplifier With Resistive Feedback And Notch Filter For UWB System*	D4-P12 **Muhammad Naim Leman (91)** *Design, Fabrication And Evaluation Of A New Keropok Keping Drying Machine*	D5-P12 **June Bong Yin Chung (80)** *The Effect Of Amine Substituent Chain Length On Polyhedral Oligomeric Silsesquioxane/Polysulfone Mixed Matrix Membrane*
0950 1010	D2-P13 **Muhammad Yasir Shamim (87) Implementation of** *Safety*	D3-P13 **Shafrida Sahrani (108)** *Modeling And Simulation Study Of A*	D4-P13 **Rashidah Salim (66)** *A Review On Ruben's Tube As Acoustic Propagator*	D5-P13 **Siti Nur Azella Zaine(79)** *Effect Of Paste Viscosity On Direct-*

	Performance Framework (SPF) in process industnes to avoid disasters	*High Speed Moving Target*		*Current Resistance In Improving The Efficiency Of Dye Solar Cell*
1010 - 1030	Tea Break Venue: Foyer			
1030 1130	Ballroom 1 Chairperson : Prof. Dr Sinin Hamdan Keynote Session 3			
1130 1230	Ballroom 1 Chairperson : Prof. Dr Sinin Hamdan Keynote Session 4			
1230 1400	Lunch Break (Imperial Garden Restaurant)			

ENCON2017 TECHNICAL PARALLEL SESSION 3

14th September 2017 (Thursday)

TIME	Parallel sessions			
	Danum 2 CE 1 Assoc. Prof. Dr Mohammad Ibrahim Safawi	**Danum 3 EE 1 Assoc. Prof Dr Mohammad Abdelmoneim**	**Danum 4 ME 1 Prof. Dr Amir Azam Khan**	**Danum 5 ChE Assoc. Prof. Dr Khairuddin Sanaullah**
1400 1420	D2-P14 **Rosmaini Tasmin (106)** *Integrating Student Class Attendance Into University Information System For Seamless Monitoring Approach*	D3-P14 **Saidu Abubakar Adamu (60)** *High-Gain Modified Antipodal Vivaldi Antenna For Ultra Wideband Applications*	D4-P14 **Ting Tiew Wei (64)** *Heat And Flow Characteristics Of Nanofluid Flow In Porous Microchannels*	D5-P14 **Nurul Afiqah Mokri (88)** *Synthesis Of High Molecular Weight Polyimide Consisting Hexafluoroisopropylidene Moiety For Gas Separation*
1420 1440	D2-P15 **Taofeeq Sholagberu Abdulkadir (6)** *Geospatial Assessment Of Soil Moisture Distribution In Mountainous Watershed Using GIS And Remote Sensing Techniques*	D3-P15 **Sylvia Ong Ai Ling (47)** Distributed Double Differential *Space-Time Coding With Amplify-And-Forward Relaying In Cooperative Communication System*	D4-P15 **Magdalene Andrew-Munot (68)** *Analysis Of Production Planning Activities In Remanufacturing System*	D5-P15 **Muhammad Ishaq Khan (8)** *Probabilistic Ecotoxicological Risk Assessment Of Imidazolium Ionic Liquids With Amino Acid And Halide Anions*
1440 1500	D2-P16 **Striprabu Strimari (115)** *Study On Influence Of Moisture Content In Cement Stabilized Serian Soil*	D3-P16 **Mohd Ridhuan Mohd Sharip, Dyg (84)** *Effect Of Interphase Region And Neighboring Particles On Electric Field Intensity Within Nanocomposite Systems*	D4-P16 **Hasanain A. Abdul Wahhab (48)** *Application Of Electromagnetic Induction Technique To Measure The Void Fraction In Oil/Gas Two Phase Flow*	D5-P16 **Dewi Harreh (49)** *Biodiesel Production From Crude Karanja Oil Using Meretrix Lyrata Synthesized Active Cao Catalyst*
1500 1520	D2-P17 **Lim Chung Han** *Use Of Quarry Dust As Sand Replacement In Structural Concrete: A Review*	D3-P17 **Ariny Demong (111)** *Tracking Of Swirl Bubbles Using High Speed Camera*	D4-P17 **Afaque Ahmed (83)** *Rheology And Interfacial Tension Of Internal Olefin Sulphonate Coated Nano-Silica For Enhanced Oil Recovery*	D5-P17 **Muhammad Babar (81)** *Simulation Based Study On Identification And Quantification Of CO2 Solidification In Cryogenic CO2 Capture From Natural Gas*
1520 1540	**BREAK**			
1540 1600	D2-P18 **Mohammad Zawawi Rosman (61)** *Time-Dependent Compressibility Behaviour Of Dredged Marine Soils (DMS) Admixed With Cement And/Or Waste Granular Materials (WGM)*	D3-P18 **Dyg Norkhairunnisa Abang Zaidel (92)** *Improvement On The Bandwidth And Scattering Parameter Performances Of 5G Branch-Line Coupler Design For The Use In Intelligent Transportation System (ITS*	D4-P18 **Nazreen Junaidi (51)** *Development Of Kek Lapis Sarawak's Automated Cooling And Pressing System By Using PLC*	D5-P18 **Latifah Abdul Ghani (94)** *The Use Of MFA And LCA In The Agriculture Waste Management System In Kuala Terengganu, Malaysia*
1600 1620	D2-P19 **Omer Iqbal (44)** *Identification Of Brittle Zones Of Potential Roseneath Shale Gas, Cooper Basin, Australia Using Geomechanical Properties And Mineralogy.*	D3-P19 **Mohammad Ashaari Kiprawi (103)** *Development Of Cutting Edge Temperature Measurement Of End Mill Tool By Infrared Radiation Technique*	D4-P19 **Abdul Basit (52)** *Droplet Spreading Behavior On Urea Pellets*	D5-P19 **Mohd Nurfirdaus Mohiddin (65)** *A Study On Chicken Fat Biodiesel Production, Characterization And Diesel Engine Performance*
1620 1640	D2-P20 **Pannir Selvam Murugiah, (78)** *A Study On The Performance Of Ppodm-CNF Mixed Matrix Membrane For CO2/CH4 Separation.*	D3-P20 **Nor Asiah Muhamad (114)** *Understanding Of High Voltage Stress Distribution Phenomena On Liquid And Solid Insulation Material Using Finite Element Method For Research Purpose*	D4-P20 **Sherra Bellina Barrabas (109)** *Hydrocarbon-Selective Catalytic Reduction As Nitrogen Oxides Emissions Reduction: A Short Review*	D5-P20 **Norwahyu Jusoh (82)** *The Effects Of Amine-Functionalization On Zeolite T/6FDA-Durene Mixed Matrix Membranes For CO2/CH4 Separation*
1640 1700	**D2P21**			**D5P21** **Muhammad Tariq Bashir (73)** *Monitoring Kinetic And Thermodynamic Parameters Of Fluoride Adsorption From Aqueous Solution By PKS-Based Anion Resins*